richardjackson
engineering consultants

GROUND INVESTIGATION REPORT

Location: Marsh Lane, King"s Lynn, Norfolk

Client: Borough Council of King"s Lynn and West Norfolk
and Lovell Partnerships Limited

April 2015

Project no: 45751

CONSULTING CIVIL, STRUCTURAL AND GEOTECHNICAL ENGINEERS

26 High Street
Hadleigh
Suffolk
IP7 5AP

Tel: 01473 825300

Document Review Sheet: -

Document prepared by: -

Chris Gray
on behalf of Richard Jackson Ltd

Signature: - ……

Date: - 27 January 2015

Document approved by: -

David Wall
on behalf of Richard Jackson Ltd

Signature: - ……

Date: - 27 January 2015

Document Status

DRAFT ☐ FINAL ☐

Revision Status

Issue	Date	Description	Author	Checker	Approved

CONTENTS:-

APPENDICIES

List of Tables **Page No.**

EXECUTIVE SUMMARY

Purpose:	A phase one desk study to document the history and environmental setting of the site and surrounding area, together with intrusive ground investigations to determine the prevailing ground conditions, to assess the contamination status and geotechnical properties of the site and determine the gassing regime beneath the site.
Site Status:	The site is currently undeveloped land located to the south of Seagrave Road and north of Marsh Lane, Kings Lynn, Norfolk.
Desk Study:	The majority of the site has remained undeveloped until 1928 when an orchard, greenhouses and wind pump are located in the eastern half of the site. By 1967, the orchard had reduced in size and buildings had been constructed in the western half of the site. These were removed by the 1990s. The site is surrounded by low-lying agricultural land from the 1880s to the 1930s. There is some residential development to the east. Further residential development occurs from the 1950s to the 1970s when a training centre is shown at the east-side and industrial buildings are shown to the west. Further residential development occurs thereafter.
Fieldwork:	The fieldwork comprised the forming of three cable percussive boreholes and eleven windowless sampler boreholes, three of which were advanced further by using dynamic probing techniques. Gas and groundwater monitoring standpipes were installed in seven of the exploratory holes and in-situ testing, sampling and logging of soils was also carried out.
Ground Conditions:	These were found to comprise Topsoil/Made Ground overlying in turn Tidal Flat Deposits, overlying the Lowestoft Formation which were in turn underlain by the Kimmeridge Clay. Groundwater strikes were recorded at various depths during the drilling and standing water levels were recorded in the wells between 0.01mbgl and 1.37mbgl.
Structural Foundations:	Conventional shallow foundations are unsuitable for the proposed development due to the underlying soft/very soft and compressible organic clays and peat layers within the Tidal Flat Deposits. Piled foundations, such as cased bored or continuous flight auger (CFA) piles, should be suitable however specialist piling contractors should be consulted with regards to their suitability, design and performance.

Ground Floor Construction:	It is recommended that suspended floor slabs are used.
Pavement Design:	A CBR value of 1% is recommended for both the Tidal Flat Deposit and Made Ground.
Groundworks	Filling of the site will generate large settlements in the underlying Tidal Flat Deposits, estimated to be a minimum of 200mm for a 1m thick fill layer. Large differential settlements are also anticipated across the site due to variations in the nature and thickness of the deposit. It is recommended that flexible surfaces and services are used on site and that filling is avoided. If filling has to be carried out, a geogrid/mattress system should be incorporated in the construction to control differential settlement.
Contamination:	An elevated arsenic concentration was recorded in a soil sample from 0.60-0.70m in WS3. Asbestos cement material containing chrysotile asbestos was recorded between 0.25m and 0.90m in made ground sampled from WS2. No elevated concentrations were recorded in the groundwater.
Remediation:	Remediation is required in soft landscaped areas around WS3. The area of remediation may be reduced by further soil sampling and analysis in order to delineate the contamination. Based on the concentration obtained to date, it is recommended that a clean cover system of 600mm would be appropriate in any areas of soft landscaping in accordance with BRE 465, Cover Systems for Land Regeneration (2004) and subject to local authority approval.
Gas Protection Measures:	Based on one set of data, the site would be classified as Characteristic Situation 2 in accordance with CIRIA C665 (2007). On completion of the gas monitoring, the recommendations for mitigation measures will be reviewed and will be presented in an addendum to this report.
Further Works:	Further intrusive work is recommended at the east end of the site where there is evidence of filled ground and where Japanese Knotweed was located at the time of the investigation. Additional site investigation to check for possible buried animal remains is also recommended. Further assessment of the risk from radon gas is also recommended.

1. INTRODUCTION

Richard Jackson Ltd received an instruction to undertake ground investigation works in connection with the proposed development of a site known as Marsh Lane, King"s Lynn, Norfolk.

The works were instructed by the Client, Lovell Partnerships Ltd.

The ground investigation comprised a phase one desk study, the purpose of which was to document the history and environmental setting of the site and surrounding area, together with phase two intrusive investigations.

The intrusive investigations comprised the forming of eleven small diameter window sampler boreholes and three deep cable percussive boreholes, together with in situ testing, sampling, geotechnical testing, chemical analysis and the installation and subsequent monitoring of ground gas standpipes.

This report assesses the findings of the desk study and intrusive investigations and gives recommendations for use in the design and construction of the proposed scheme. Chemical analysis has been undertaken in order that the contamination status of the site may be determined and the need for any further investigation or remediation assessed.

This report shall be read in conjunction with the limitations as provided in Appendix I.

2. PROPOSED DEVELOPMENT

It is proposed to develop the site predominantly for residential purposes, constructing a range of dwellings, together with access roads, gardens, open spaces, driveways and associated infrastructure. Proposed Development Plans are provided in Appendix A.

3. PHASE ONE DESK STUDY FINDINGS

The desk study has been compiled using historic Ordnance Survey maps dating back to 1883, together with environmental data provided by Centre Maps Live. This information is provided in Appendix G.

3.1. Site Location & Description

The site is located to the south of Seagrave Road and north of Marsh Lane, Kings Lynn. The site is currently undeveloped land.

The approximate Ordnance Survey grid reference for the centre of the site is TF 634 216. A site location plan is presented as Figure 1 in Appendix A, with photographs taken at the time of walkover presented in Appendix B.

The site is irregular in shape with maximum dimensions of 350m east to west by 240m north to south. The northern boundary is formed by an approximately 1.8m close board and paling fencing with a 1.2m high soil bund located centrally to prevent unauthorised access from Seagrave Road to the site. Beyond the northern site boundary is a mix of residential development also accessed from Seagrave Road. The eastern boundary is formed by an approximately 1.8m close board and approximately 1.5 m high chain link fence. Residential development and associated gardens exist beyond the northern end of this boundary, with a school existing beyond the southern end.

The southern boundary is predominantly formed by a tarmac footpath, beyond which exist dwellings associated with Calamint Road. Two detached dwellings with gardens are located centrally along the southern boundary, separated from the site by approximately 1.8 m close board fencing. As the southern boundary progresses eastwards, it is formed by Marsh Lane, beyond which exists residential development associated with Aconite Road. The western boundary is formed by scrub and Willow trees up to approximately 18m high and beyond by a tarmac footpath and water-filled ditch. Industrial units accessed from Bryggen Road and Hamburg Way exist beyond.

The site is predominantly vacant grass marshland with an Apple Orchard in the eastern third of the site, a water-filled channel orientated north to south and located centrally and rectangular concrete hardstanding areas prominent in the western third of the site. Water filled ditches are located adjacent to the eastern half of the northern boundary and the western half of the southern boundary. A concrete base was also noted close to the south-east corner of the site. A grass mound is prominent adjacent and along the length of the northern half of the eastern boundary.

The western third of the site is slightly raised relative to the remainder of the site however both areas are approximately level.

Japanese Knotweed has been recorded close to the northeast corner of the site. Anecdotal information obtained during the site walkover indicated that the site had been a piggery and pigs may be buried on-site.

3.2. Site History

Table 1, below, provides a summary of the history of the site and surrounding area.

Table 1: Summary of Site History

Ordnance Survey Map Dates	Scale(s)	On Site History	Surrounding Area History
1883 - 1887	1:2,500 / 1:10,560	The majority of the site is a single parcel of land with two separate parcels encroaching on the site along its northern boundary. A drainage ditch is orientated north-south close to the centre of the site and east-west close to the northern site boundary. Non-Coniferous Trees are shown dotted along the eastern half of the northern site boundary and the northern half of the eastern site boundary. The site is undeveloped.	The Lynn and Hunstanton Branch Railway Line is orientated north-south adjacent to the western site boundary. A Sheepfold is located immediately beyond the centre of the southern boundary and Marsh Lane is orientated east west adjacent to the eastern half of the southern site boundary. The closest built structures are located approximately 250m to the southeast and are residential. A Cornmill exists around 220m east of the site boundary. A second railway line orientated east-west is shown circa 250m southeast of the site boundary. Bawsey Drain (flowing west) and Gaywood River are shown approximately 240m south and around 270m southeast of the site boundary. Development associated with South Wootton is noted around 500m north northeast of the site boundary. Otherwise undeveloped agricultural fields appear to exist within the immediate site area.
1904 - 1905	1:2,500 / 1:10,560	The site is unchanged except the non-coniferous trees are no longer shown. A small structure now exists in the southeast site corner.	The sheepfold previously noted close to the centre of the southern boundary is no longer shown. A footpath is shown adjacent to the western two thirds of the southern boundary. The Corn Mill previously noted to the east is no longer shown. The railway line orientated east-west circa 250m southeast of the site boundary is noted to be „Abandoned".
1927 - 1928	1:2,500 / 1:10,560	Further partitioning of the site has taken place with an Orchard shown in the eastern half of the site and buildings with the annotation „Windpump" noted close to the southeast corner of the site. A small structure is shown centrally in the south of the site.	Garden ground associated with further comparatively small residential development is adjacent to the northeast boundary of the site and an Orchard is close to the northeast corner of the site. Further Orchards are noted approximately 250m and 500m south east of the site and around 500m northeast of the site. Development associated with Gaywood and/or South Wootton is noted circa 250m east of the site boundary.
1938	1:10,560	The site is unchanged.	The surrounding area is largely unchanged with further residential development shown adjacent to Marsh Lane within 30m southeast of the site.

Table 1: Summary of Site History…..continued

Ordnance Survey Map Dates	Scale(s)	On Site History	Surrounding Area History
1950 - 1951	1:10,560	The site is unchanged except a comparatively small building is shown close to the western boundary of the site and buildings previously noted close to the southeast corner of the site are no longer annotated as „Windpump".	The surrounding area is largely unchanged with two comparatively small buildings noted centrally close to the southern site boundary and an electrical sub-station is noted approximately 420m east south east of the site boundary.
1958	1:10,560	The site is unchanged.	The surrounding area is largely unchanged except the electrical sub-station previously noted 420m east south east of the site boundary no longer shown.
1967	1:1,250 / 1:2,500	The aforementioned orchard is shown to have reduced in area to the eastern third of the site. A large rectangular building orientated north south is shown close to the drainage in the centre of the site. A further four rectangular buildings - one comparatively large - are shown in the western third of the site. A drainage ditch is shown adjacent to the eastern two thirds of the northern site boundary. The structures previously noted in the southeast have been redeveloped and extended. The previously noted structure in the south has been redeveloped and is now listed as a nursery.	Land and buildings associated with a „Comprehensive Training Centre" are now shown adjacent to the southern half of the eastern site boundary. Residential development has replaced the Orchard previously noted close to the northeast corner of the site and is also shown approximately 10m from the southwest corner of the site. An electricity pylon and associated electricity transmission line are shown circa 25m southeast of the site boundary.
1974	1:10,000	The site is unchanged.	The orchards previously noted approximately 500m southeast and northeast of the site boundary are no longer shown.
1978	1:1,250 (partial coverage)	Only one comparatively small building remains close to the southeast corner of the site. No detail of the western half of the site is provided.	Land and buildings associated with a „Comprehensive Training Centre" previously shown adjacent to the southern half of the eastern site boundary are now annotated „Alderman Jackson School". Residential development is now shown beyond the footpath to the immediate south of the site.

Ordnance Survey Map Dates	Scale(s)	On Site History	Surrounding Area History
			Residential development and an electricity station are now located approximately 120m beyond the western end of the northern site boundary.
1984	1:10,000	No buildings are shown in the western half of the site.	North Lynn Industrial Estate is now shown around 150m east of the site boundary. Otherwise the surrounding area is largely unchanged.
1989-1994	1:1,250 (partial coverage) / 1:10,000	Scrub is shown immediately to the east of the drainage ditch in the centre of the site. The approximate western half of the site is unchanged. No detail of the western half of the site is provided. By 1990 the previously noted structures in the southeast are no longer shown.	The orchard previously noted approximately 250m to the southeast is absent by 1990. The remaining surrounding area is largely unchanged.
2002	1:10,000	Scrub previously shown immediately to the east of the drainage ditch in the centre of the site and the Orchard previously noted in the eastern third of the site are no longer shown.	Residential development is now shown immediately beyond the entire northern site boundary. North Lynn Industrial Estate is now shown to be approximately 30m west of the site boundary.
2010 - 2014	1:10,000	The site remains unchanged, being predominantly unoccupied land with drainage ditches existing in the northwest and centre of the site and isolated structures existing centrally in the south.	The surrounding area remains predominantly unchanged comprising extensive residential development in all directions. A school exists to the east southeast and an industrial estate exists to the northwest.

3.3. Geology & Geological Hazards

The British Geological Survey 1:50,000 Digital Geological Map of Great Britain, indicates the site to be underlain by Made Ground overlying Tidal Flat deposits comprising clay and silt; Lowestoft Formation comprising diamiction; and mudstone of the Kimmeridge Clay Formation.

A moderate risk of compressible ground and running sand hazards has been identified and this is likely associated with the Tidal Flat Deposits. A low risk from shrink and swell stability hazards is considered to exist at the site.

BRE document „Radon Guidance on Protective Measures for New Buildings", 2007 indicates some parts of the 1km grid square in which the site is located are in bands of elevated radon potential. The maximum radon potential for these areas is 1-3 %. Either basic radon protection measures will need to be installed within structures at the site or a BR211 Radon Report should be obtained for the site. The BR 211 Radon Report will indicate whether basic protection or no protection is required at the site.

3.4. Hydrology & Hydrogeology

The Tidal Flat Deposits Lowestoft Formation and Kimmeridge Clay Formation are classified as unproductive strata in terms of aquifer potential and are typically considered to have negligible significance for either river base flow or water supply.

The site does not lie within a Source Protection Zone (SPZ) and no SPZs exist within 500m of the site.

Bawsey Drain flows west approximately 240m south of the site boundary and Gaywood River is shown circa 270m southeast of the site boundary.

There are no groundwater abstraction licences within 2km of the study site. There are four surface water abstraction licences within 500m of the study site, the closest of which is a point source for Spray Irrigation - Direct from Drains Area South Wootton located approximately 405m north of the site (Licence No: 6/33/61/*S/0020).

There is one potable water abstraction licence within 2km of the study site which is a point source for spray irrigation, general farming and domestic, and cooking sanitary, washing from Gaywood River circa 640m south of the site (Licence No: 6/33/61/*S/0049).

The site is listed to be within an Environment Agency (EA) Zone 3 floodplain. A Zone 3 floodplain refers to the area likely to be affected by a flood event from rivers with a 1% chance of occurring in a year or from the sea with a 0.5% chance of occurring in a year. The site is indicated to be located within an area benefitting from flood defences.

The site is also located within 50m of a BGS Superficial Deposits groundwater flooding susceptibility area with the potential for groundwater flooding to occur at the surface i.e. Moderate Groundwater Flooding Confidence Area.

3.5. Pollution & Industrial Activity

There are seven potentially contaminative industrial land uses listed within 100m of the site, with the nearest two recorded as being an

„Industrial Engineers" and „Food and Beverage Industry/Machinery" approximately 45m west of the site. Other potentially contaminative industrial land uses within 100m include electricity sub-station, agricultural contractors and vehicle repair, testing and servicing facilities.

There is one petrol or fuel site record within 500m of the site, associated with a Tesco Express site approximately 385m east of the site.

Ten licensed discharge consents exist within 500m of the site. One of which is on-site and associated with miscellaneous emergency discharges from Marsh Lane (Permit Number: AECNF2449). The consent was revoked on the 22/5/1992. There are no records of Red List Discharge Consents within 500m of the site.

There are two records of List 2 dangerous substances inventory sites within 500m of the site. The authorised substance for both sites is pH - with a not active status – circa 300m to the south (Eastern Electricity) and around 415m to the west (Williams Refrigeration Ltd) of the site. There are no records of List 1 dangerous substances inventory sites, radioactive substances authorisations, hazardous substance consents and enforcements or COMAH & NIHHS sites within 500m of the site.

There are four EA recorded pollution incidents listed within 500m of the site. Incident identification: 40957 involved fumes and occurred approximately 445m west of the site in 2001. The incident was recorded to have had a minor impact on air and no impact on water and land. Incident Identification: 67227 involved smoke and occurred circa 445m west of the site in 2002. The incident was recorded to have had a minor impact on air and no impact on water and land.

There are two records of IPC Authorisations within 500m of the site both of which are associated with the manufacture and use of organic chemicals at a site around 295m to the northwest. Both entries are historic, with one being superseded and the other revoked.

There are seven Part A (2) and Part B Activities and Enforcements within 500m of the site. The nearest activity is a vehicle refinishing process with a „Current Permit" status located approximately 65m northwest of the site (Bennetts Motor Company). The nearest enforcement was a regulation 36 notice for a petrol station process with a „Current Permit" status located circa 375m east of the site (Tesco Express).

3.6. Landfill

One Waste Transfer Station is listed within 500m of the site. North Lynn Allotment Gardens located around 455m to the southwest was granted detailed planning permission on 14th March 2006 for a scheme comprising community composting to process biodegradable garden waste collected from the local community.

There are no active or historic landfill sites, waste treatment or disposal sites listed within 500m of the site.

3.7. Environmentally Sensitive Areas

No SSSI, ESA, Local or National Nature Reserves or Country Parks are listed within 500m of the site.

3.8. Risk Assessment

3.8.1. Regulatory Regime

Contaminated Land is defined under Section 78A (2) of the Environmental Protection Act 1990, Part IIA as follows:

"Any land which appears to the Local Authority in whose area it is situated to be in such a condition, by reason of substances in, on, or under the land that:

a) Significant harm is being caused, or there is significant possibility of such harm being caused, or

b) Pollution of controlled waters is being or is likely to be caused."

Thus land can be defined as contaminated if it is causing significant harm or where substances in, on or under the land are polluting a controlled water or if there is a significant risk of this happening.

Part IIA of the Act introduces the concept of "pollutant linkages". This is that in order for land to be considered to be contaminated there must be a contaminant or pollutant source, an exposure pathway by which that contaminant reaches a receptor and the receptor or target itself. If one or more of the elements is missing the land cannot be determined to be contaminated.

In addition to the above the National Planning Policy Framework (NPPF) encourages a positive and proactive approach to secure developments which improve an area socially, economically and environmentally. Consideration should be given to the NPPF during the development of a proposed scheme.

3.8.2. Potential Sources of Contamination

The eastern half of the site has remained largely undeveloped throughout the examined period (1883 - 2014), with an orchard located in the eastern half of the site between 1927 and 2002 and comparatively small buildings - initially with the annotation „Windpump" - noted close to the southeast corner of the site between the late 1920s and early 1990s.

A large rectangular building and a further four rectangular buildings were shown centrally and in the west of the site between the 1960s and the 1980s.

A concrete base was noted close to the southwest corner of the site during the site walkover. A grass mound was noted during the site walkover adjacent and along the length of the approximate northern half of the eastern boundary. Japanese Knotweed has been recorded close to the northeast corner of the site. Anecdotal information obtained during the site walkover indicated that part of the site had been used as a piggery and pigs may be buried on-site.

A potential for Made Ground associated with the aforementioned buildings and grass mound is considered to exist, however, it is unlikely to have affected the site as a whole.

The Lynn and Hunstanton Branch Railway Line existed adjacent to the western site boundary until 1990. Otherwise, the surrounding area has historically been predominantly undeveloped agricultural fields, over time becoming predominantly residential development with an Industrial Estate approximately 30m west of the site boundary. There is a low likelihood of contamination associated with the Railway Line otherwise these land uses are considered to be an unlikely potential source of contamination.

A potential for Radon to affect the site is considered to exist, however, further investigation as discussed in Section 3.2 is required to quantify this risk and thus Radon has been omitted from the CSM subject to further assessment.

Potential sources of contamination therefore include:

- Made Ground
- Soil Mound

Potential contaminants include:

- Acids

- Hydrocarbons (PAHs and TPHs)
- Heavy Metals
- Hazardous Ground Gases
- Asbestos

3.8.3. Potential Receptors of Contamination

Humans, including end users of the site, site workers and the general public may be considered potential receptors of contamination through ingestion, inhalation or dermal contact.

Structures and services are considered as potential receptors of contamination through direct contact with contaminated soils.

Flora is considered to be a potential receptor of contamination through uptake of contamination through roots.

The on-site drainage ditches may also be considered potential receptors of contamination through leaching of contaminants in the soils.

3.8.4. Preliminary Conceptual Model and Risk Assessment

From the preceding sections, plausible potential pollutant linkages may be proposed for the site and level of risk assigned. A preliminary qualitative risk assessment has been undertaken, which considers the magnitude of the potential consequence (severity) of the risk occurring, the magnitude of the probability (likelihood) of the risk occurring and provides an overall risk classification.

Table 2, below, details the relationship between probability, consequence and risk used in the assessment and is based on guidance given in CIRIA Report C552 „Contaminated Land Risk Assessment. A Guide to Good Practice" 2001.

Table 2: Relationship between probability, consequence and risk

		Consequence			
		Severe	**Medium**	**Mild**	**Minor**
Probability	**High likelihood**	Very high risk	High risk	Moderate risk	Moderate/ low risk
	Likely	High risk	Moderate risk	Moderate/ low risk	Low risk
	Low likelihood	Moderate risk	Moderate/ low risk	Low risk	Very low risk
	Unlikely	Moderate/ low risk	Low risk	Very low risk	Very low risk

This risk assessment is based on the findings of the desk based research. Intrusive investigations will be required in order to fully investigate the pollutant linkages identified and quantify the risk.

Table 3, over, presents the preliminary conceptual model.

Table 3: Preliminary Conceptual Model: On Site / Off Site Sources

Contaminants	Source	Pathway	Receptor	Consequence of risk being realised	Probability of risk being realised	Risk classification
Acids, Hydrocarbons, Heavy Metals	Made Ground, Soil Mound	Direct Contact, Ingestion, Inhalation	End Users, Site Workers, General Public	Medium	Low Likelihood	Moderate / Low
		Direct Contact	Structures & Structures	Mild	Low Likelihood	Low
		Uptake by Roots	Flora	Mild	Low Likelihood	Low
		Leaching	Controlled Waters	Medium	Low Likelihood	Moderate / Low
Asbestos	Made Ground, Soil Mound	Inhalation	End Users, Site Workers, General Public	Severe	Low Likelihood	Moderate

4. FACTUAL GROUND INVETIGATION INFORMATION

The factual ground investigation information is provided in the following section.

4.1. Fieldwork

The fieldwork was undertaken between 16th December 2014 and 8th January 2015 and comprised eleven small diameter window sampler boreholes (WS1 - WS10 & WS12) and three deep cable percussive boreholes (BH1 - BH3). Six semi-permanent gas monitoring standpipes were installed. Gas monitoring at the site is ongoing.

WS11 was not formed due to its proposed location being within an area of Japanese Knotweed.

An exploratory hole location plan is presented on the topographical survey of the site as Figure 2 in Appendix A.

Where applicable, investigation techniques, sampling, logging of soils and in situ testing complied with the requirements of British Standard BS5930 - „Code of Practice for Site Investigations".

4.1.1. Window Sampling

The window sampling utilised a track-mounted hydraulic power pack and percussive hammer to drive a series of small diameter windowless tubes into the ground.

The window sampler boreholes were formed to a depth of between 3.00m and 4.00m. WS6 and WS7 were advanced by dynamic probing to 8.5m and 9.0m respectively. Dynamic probing was also undertaken from the ground surface adjacent to BH2 to 8m below ground level (bgl).

Window sampler boreholes were positioned to provide representative coverage of the site. WS5 was formed to target the large rectangular building close to the centre of the site as identified on historic maps. WS1 and WS3 were formed to target the rectangular buildings in the western third of the site. WS2 was drilled where a concrete base was noted during the site walkover.

Due to the presence of Japanese Knotweed close to the northeast corner of the site it was not possible to obtain site-specific information for the grass mound adjacent and along the length of the northern half of the eastern boundary.

Disturbed and bulk samples were recovered from throughout the depth of each borehole for possible future chemical analysis or geotechnical

testing. Samples recovered for chemical analysis were recovered in air-tight plastic containers, amber glass jars and clear glass vials (WS3 and WS5 groundwater samples only) transported to the analytical laboratory in cool boxes under chain of custody.

Cone Penetration Tests (CPTs) were undertaken throughout the depth of the window sampler boreholes to assess the penetration resistance of the encountered soils. The number of blows required to advance a 60° nose cone over the final 300mm of a 450mm total drive was recorded as the „N" value and is presented on the borehole records.

Where cohesive soils were encountered, a hand shear vane was used to assess the undrained shear strength of the encountered materials. The results of these tests are presented as the IVN value of the borehole logs.

Upon completion of three of the window sampler boreholes (WS3, WS5 and WS8), semi-permanent HDPE gas monitoring standpipes were installed to a maximum depth of 3.5m. Details of the standpipes" construction is provided in the borehole records.

Window sampler borehole logs are presented in Appendix B and give both depths and descriptions of strata encountered together with details of samples taken, in situ tests and any other relevant information.

4.1.2. Cable Percussive Boreholes

Three cable percussive boreholes (BH1 - BH3) were formed to a depth of 15.0m bgl.

Cable percussive boreholes were positioned to provide a representative coverage of the site. BH3 was formed to target the location of the comparatively small buildings noted on historical maps to exist close to the southeast corner of the site. BH1 was formed to target the rectangular buildings in the western third of the site.

Disturbed, bulk and undisturbed samples were recovered from throughout the depth of the boreholes.

Standard Penetration tests (SPTs) and Cone Penetration Tests (CPTs) were undertaken throughout the depth of the boreholes to assess the penetration resistance of the encountered materials. The number of blows required to advance a standard split spoon or 60° nose cone over the final 300mm of a 450mm total drive is recorded as the „N" value on the borehole logs.

Upon completion of the cable percussive boreholes, HDPE gas monitoring standpipes were installed to a maximum depth of 7.0m.

Details of the standpipe construction is provided in the borehole records.

Cable percussive borehole logs are presented in Appendix B and give both depths and descriptions of strata encountered, together with details of samples taken, in situ tests and any other relevant information.

4.1.3. Gas Monitoring

The standpipes installed within the boreholes WS3, WS5, WS8, BH2 & BH3 have been monitored on one occasion since installation for the presence of methane, carbon-dioxide and oxygen using and infra-red portable gas analyser. This monitoring visit was undertaken prior to completion and installation of BH1. Gas flow and atmospheric pressure have also been monitored.

Measurements of the depth to the base of the installation were also taken to confirm the quality of the installation.

Five further visits are planned to monitor ground gases, the results of which will be reported under separate cover at a later date.

Table 4, below, provides a summary of the gas monitoring results to date. Full results are presented in Appendix E, alongside the calibration certificate for the infrared potable gas analyser.

Table 4: Summary of Gas Monitoring Results (to date)

Borehole	Range of O_2 (% v/v)	Range of CO_2 (%v/v)	Range of CH_4 (%v/v)	Range of Flow Rates (l/hr)
WS3	18.9	1.6	0	0.6
WS5	19.2	0.5	0	0.7
WS8	18.5	5.8	0	0.6
BH1	-	-	-	-
BH2	19.1	0.3	0	0.9
BH3	19.8	0.6	0	0.7

4.1.4. Groundwater Monitoring

The standpipes installed within the boreholes (WS3, WS5, WS8, BH2 & BH3) have been monitored on at least one occasion since installation.

The monitoring visits were undertaken prior to completion and installation of BH1.

Measurements of the depth to the base of the installation were also taken.

A further 5 visits are planned to monitor groundwater levels, the results of which will be reported under separate cover at a later date.

Table 5, below, provides a summary of the groundwater monitoring results to date. Full results are presented in Appendix E.

Table 5: Summary of Groundwater Monitoring Results (to date)

Borehole	Date	Groundwater Level (m bgl)	Base of Installation (m bgl)
WS3	18/12/2015	1.37	3.52
	07/01/2015	1.26	3.54
WS5	18/12/2015	0.97	3.55
	07/01/2015	0.80	3.49
WS8	18/12/2015	0.10	2.70
	07/01/2015	0.01	2.71
BH1	-	-	-
BH2	07/01/2015	0.29	5.88
BH3	07/01/2015	0.94	6.00

4.2. Ground Conditions

As discussed in Section 3.3, Made Ground, Tidal Flat Deposits, Lowestoft Formation and Kimmeridge Clay Formation are indicated to exist beneath the site. This investigation encountered a sequence of strata as follows:

- Topsoil
- Made Ground
- Tidal Flat Deposits
- Lowestoft Formation

- Kimmeridge Clay Formation

4.2.1. Topsoil

Topsoil was encountered at the surface in six of the exploratory boreholes and ranged in thickness from 0.10m (WS5 & WS8) to 0.30m (WS10).

The Topsoil was typically encountered as slightly sandy, silty clay with occasional roots and rootlets with the exception of BH2 which encountered clay.

4.2.2. Made Ground

Made Ground was encountered beneath the Topsoil in BH3 and at the surface in eight locations.

The thickness of the Made Ground varied across the site, with a 2.00m thickness recorded in the southeast corner of the site (BH3). Made ground thicknesses ranged from 0.50m (WS3) to 1.00m (WS1) in the location of the historic rectangular buildings in the western third of the site and 1.45m thickness recorded where a concrete base was noted during the site walkover. The thickness of the Made Ground encountered elsewhere on site was recorded to be between 0.30m (WS12) to 1.00m (WS7).

The Made Ground was encountered as a variable material, typically comprising slightly sandy, silty clay containing concrete, brick and ash of varying proportions. The Made Ground encountered in WS2 was also noted to contain occasional fragments of asbestos.

4.2.3. Tidal Flat Deposits

Soils interpreted to represent the Tidal Flat Deposits were encountered beneath the Topsoil or Made Ground in all borehole locations, the maximum thickness recorded being 5.90m at borehole BH1. Windowless sampler holes WS1, WS2, WS3, WS4, WS5, WS6 and WS7 terminated in the deposit so its full thickness was not established at these locations. The peat layers were encountered at a similar depth across the site.

The Tidal Flat Deposits were generally encountered as silty, locally organic, clays with layers of peat ranging from fibrous to amorphous and layers of sand/sandy gravel.

At borehole BH1, where the thickness of the deposit was greatest, a sequence of soft clays, becoming organic with depth and with an occasional sand layer, were found to 4.00mbgl overlying a peat layer to 5.30m which was in turn underlain by soft organic clay. This cohesive

deposit was underlain by clayey fine to medium sand, which may be indicative of the base of this superficial deposit or possibly a granular unit at the top of the Lowestoft Formation.

By comparison, at the east end of the site, at boreholes BH2 and BH3, the thickness of the soft Tidal Flat Deposit was reduced and comprised firm clay to 1mbgl over slightly sandy gravel to 1.90m at borehole BH2 and soft/very soft sandy, slightly sandy/slightly gravelly clays to 2.70m at borehole BH3. At windowless sampler hole WS12, to the north-west of borehole BH3, the Tidal Flat Deposit, was found to 3.65m bgl. These variations in depth to the base of the Tidal Flat Deposit may be indicative of a possible edge to a buried river channel.

The majority of the windowless sampler holes terminated in the Tidal Flat Deposit however at boreholes WS8, WS9, WS10 and WS12, the base of the layer was noted at 3.50m (WS8 and WS9), 1.85m and 3.65m respectively.

The soft, compressible, organic nature of the deposit was a likely cause of the reduced sample recovery during the windowless sampling. The greatest thickness of peat was recorded between windowless sampler boreholes WS6 and WS8 where the unit ranged in thickness between 1.95m and 2m, however the reduced recovery in a number of holes may be indicative of peat which has either been compressed or displaced during sampling. Windowless sampler holes WS1, WS2, WS3 and WS4 all terminated in peat layers.

The hand shear vane tests carried out in the cohesive parts of the deposit indicated that, in general, undrained shear strength decreased with depth and predominantly indicated a consistency ranging from firm to very soft. At depths of 1.00m/1.10m, measured undrained shear strengths recorded by the hand vane at boreholes WS6 and WS8 were high for a normally consolidated deposit, possibly indicating that the clays were desiccated at these locations.

An oedometer test carried out on an undisturbed sample from 5mbgl at borehole BH1, indicated that the soil was in the high compressibility range with m_v values between 0.30-1.50m^2/MN. According to Tomlinson (MJ Tomlinson, Foundation Design and Construction, 2001) this is typical for normally consolidated alluvial clays.

Standard Penetration Tests (SPTs) were undertaken throughout the depth of the Tidal Flat Deposits to assess the relative density and stiffness of granular and cohesive parts of the deposit respectively. The SPT N value indicate against Depth Plot given in Appendix H indicated that most of the profiles decrease slightly from shallow depth before increasing, possibly indicating that there is a firm crust at the top of the deposit which is underlain by softer soils.

The results of the SPT tests are presented on the logs included in Appendix B and the SPT N value Against Depth Plot given in Appendix H.

Window sampler holes WS6 and WS7, located in the central part of the site, were extended to depths of 8.50m and 9.00m respectively by dynamic probing. In addition, a dynamic probe hole, DP201, was sunk 1m from borehole BH2 to a depth of 8.00m, to provide a correlation with the light cable percussive borehole. The objective of the dynamic probing was to assist with correlation of deposits encountered in the light cable percussive boreholes.

The dynamic probe hole DP201, which was sunk adjacent to borehole BH2, showed a similar trend of increasing N value with depth to that shown by the SPT N value profile in borehole BH2. By comparison, the dynamic probing carried out at the base of boreholes WS6 and WS7 was much lower between 4 and 5mbgl, which was to be expected as both holes terminated in normally consolidated soft clays whereas at the same depth in borehole BH2, the over-consolidated clay was classified as stiff to very stiff (high to very high strength) clays by the unconsolidated undrained triaxial strength tests. The dynamic probe (DP N_{300}) profiles for DP201, WS6 and WS7 and the SPT N value profile for borehole BH2 appear to converge between 5mbgl and 6mbgl suggesting that the base of the Tidal Flat Deposits at WS6 and WS7, may be within this depth range. Below 5.5mbgl, all of the DP N_{300} profiles show a marked increase in N value, with depth, which are broadly consistent with the increasing SPT N values and undrained shear strength profiles for the light cable percussion boreholes.

Atterberg limits were determined for four samples of the Tidal Flat Deposits, the results of which are summarised in Table 6 and provided in Appendix C.

Table 6: Atterberg Limits for the Tidal Flat Deposits

Borehole	Depth, bgl (m)	Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Modified Plasticity Index* (%)
BH3	2.0	53	85	36	49	49
WS1	1.35-1.45	17	34	22	12	12
WS6	0.90-1.00	27	53	23	32	32
WS7	1.00-1.45	33	58	25	33	33

*Modified Plasticity Index = (Plasticity Index X % sample passing 0.425mm sieve) / 100

From the above it is evident that the Tidal Flat Deposits are a variable material typically of low to very high plasticity with a low to high volume change potential.

4.2.4. Lowestoft Formation

Soils interpreted to represent the Lowestoft Formation were encountered beneath the Tidal Flat Deposit in boreholes BH1, 2 and 3 and windowless sampler holes WS8, 9 and 12.

The deposit generally comprised firm to stiff brown and grey slightly gravelly to gravelly, slightly sandy clay with the gravel consisting of chalk and flint. The deposit was found to depths of 9.50m, 10.50m and 6.60m at boreholes BH1, BH2 and BH3 respectively and reached a thickness of 8.60m at borehole BH2, in the north-east corner decreasing to 2.70m to the west at borehole BH1 and 3.10m at borehole BH3 in the south.

Standard Penetration Tests were undertaken throughout the depth of the Lowestoft Formation to assess the stiffness of the deposit. The results of these tests, which are presented on the logs included in Appendix B and on the Standard Penetration Test (SPT) N value against Depth Plot given in Appendix H indicate that the N values range from 12 to 19.

Unconsolidated undrained triaxial tests carried out on undisturbed samples indicated that the undrained shear strengths varied from 103kN/m^2 to 251kN/m^2 (high strength to very high strength).

Atterberg limits were determined for three samples of the Lowestoft Formation, the results of which are summarised in Table 7 and provided in Appendix C.

Table 7: Atterberg Limits for the Lowestoft Formation

Borehole	Depth, bgl (m)	Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Modified Plasticity Index* (%)
BH2	5.5	18	37	17	20	18
WS9	3.5	22	39	18	21	20
WS12	3.65	25	48	22	26	24

*Modified Plasticity Index = (Plasticity Index X % sample passing 0.425mm sieve) / 100

From the above it is evident that the Lowestoft Formation is of intermediate plasticity, with a low to medium volume change potential.

4.2.5. Kimmeridge Clay Formation

Soils interpreted to represent the Kimmeridge Clay Formation were encountered beneath the Lowestoft Formation in the cable percussive boreholes, BH1, 2 and 3.

The deposit was encountered as a grey clay overlying weak grey mudstone recovered as gravel-size fragments and/or slightly fissile thinly laminated dark grey clay with traces of white shell fragments.

Standard Penetration Tests (SPTs) and Cone Penetration Tests (CPTs) were undertaken throughout the depth of the Kimmeridge Clay Formation to assess its penetration resistance. The results of these tests are provided in full on the logs included in Appendix B and on the Standard Penetration Test N Value against Depth Plot given in Appendix H.

The unconsolidated undrained triaxial shear strength tests indicated that the undrained shear strength of this deposit varied from 116 to 169 kN/m^2 (high strength to very high strength).

Atterberg Limits were determined for three samples of the Kimmeridge Clay Formation, the results of which are summarised in Table 8 and provided in full in Appendix C.

Table 8: Atterberg Limits for Kimmeridge Clay Formation

Borehole	Depth, bgl (m)	Moisture content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Modified Plasticity Index* (%)
BH1	11.0	32	59	35	24	14
BH2	11.5	24	62	25	37	37
BH3	8.1	37	51	33	18	12

The Atterberg limit tests have classified the deposit as high plasticity silt/clay.

4.2.6. Groundwater

Groundwater was recorded in the gas monitoring wells at depths of between 0.01mbgl in windowless sampler hole WS8 and 1.26mbgl in windowless sampler hole WS3. Details of the groundwater levels are included with the ground gas monitoring data presented in Appendix E.

During the site investigation, groundwater was encountered in the light cable percussion boreholes as perched water or seepages/water strikes in the Tidal Flat Deposit or as water strikes/seepages in the Kimmeridge Clay. Details of the groundwater encountered during the investigation are presented on the borehole logs in Appendix B and in Table 9.

Table 9: Details of groundwater strikes encountered during the site investigation.

Borehole	Depth of water strike, m bgl	Depth of casing m bgl	Rose to (5mins)	Rose to (10 mins)	Rose to (15 mins)	Sealed out at m bgl
BH1	6	5.7	5.5	5.5	5.5	7
BH2	1.2	-	0.8	0.6	0.4	1.9
BH3	3.1 (seepage)	3.0	No rise	No rise	No rise	3.5
BH3	7.1 (seepage)	4.5	No rise	No rise	No rise	7.2
BH3	8.1	4.5	7.4	6.8	6.3	10.7

5. GEOTECHNICAL ASSESSMENT

It is understood that the development proposed for the Marsh Lane site is for housing with associated garages, parking areas, gardens and access roads. An existing wooded area, previously an orchard, is to be incorporated in to the eastern half of the site.

Exact details of the building design loads were unknown at the time of writing however these were considered to be consistent with loads for a typical 2/3 storey dwelling. It is anticipated that ground floor slabs are not likely to be significantly loaded.

5.1. Structural Foundations

5.1.1. Shallow Foundations

The site investigation has confirmed that beneath a superficial clay topsoil/made ground layer, the natural deposits comprise predominantly cohesive, locally organic, Tidal Flat Deposits. Within this deposit, amorphous and fibrous peat layers are up to 1.95m/2.00m in thickness in the central part of the site, in the vicinity of WS6 and WS8. Further to

the west, the window sampler holes terminated within this deposit so the full thickness and nature of these soils could not be determined at these locations.

Dynamic probing carried out at windowless sampler holes WS6 and WS7, in the central area, suggest that the geological deposits become noticeably more competent between 5 and 6mbgl, possibly indicating the boundary between Tidal Flat Deposits and underlying Lowestoft Formation. Therefore, across the site, the thickness of this compressible deposit ranges from 5.90m at borehole BH1 in the west, to between 5 and 6m at WS6 and WS7 in the central part of the site, to 1.70m in borehole BH2, in the north-east corner and approximately 2.50m at borehole BH3, in the south-east corner. However, the full thickness of this deposit could not be determined by window sampling in the western part of the site.

Shallow foundations, such as strips or pads, supporting the proposed buildings and bearing above or in the Tidal Flat Deposits will not be suitable for the anticipated building line loads due to the low strength and high compressibility of these normally consolidated soils. The very high water table recorded on 18 December 2014 and 7 January 2015 during the gas/groundwater monitoring visits will also preclude the use of shallow foundations as groundwater ingress into excavations is likely to be difficult to control.

For these reasons, a piled solution is the recommended option for the site.

5.1.2. Piled Foundations

Due to the proximity of residential areas to the site, foundation types such as driven piles which are likely to cause noise disturbance or ground vibration during pile emplacement are likely to be unsuitable for the proposed development.

Cased bored piles or continuous flight auger (CFA) piles are likely to create less disturbance and should be suitable for the ground conditions encountered during the ground investigation. The geotechnical information presented in this report should be provided to the piling contractor who can advise on the best options for piling the site and to enable them to design suitable foundations for the proposed development.

Preliminary pile calculations have been undertaken to determine the theoretical safe working loads for 14m long piles of diameters 300mm and 450mm on the basis of the encountered soils and the determined parameters.

A number of assumptions have been made to enable these preliminary calculations to be undertaken and these are summarised below:

- We have assumed that negative skin friction will act on the pile shaft for the top 6m. For an assessment of negative skin friction we have assumed an average undrained shear strength of 30kN/m^2;
- A global factor of safety of 2.5 has been applied to the ultimate pile loads to provide safe working loads. In all instances, a safety factor of 2.5 applied to the combined shaft and base loads is more conservative than a safety factor of 3 applied to the base load and 1.5 to the shaft load;
- Groundwater has been assumed to be at 1mbgl;

The following equation has been applied to determine the ultimate capacity of the pile:

$$Q_u = Q_s + Q_b$$

Where;

$$Q_{s\ granular} = 0.5 * K_s * P * (Z_1+Z_2) * \tan(0.75\Phi)$$

$$Q_{s\ cohesive} = \alpha * C_{u\ shaft} * A_s,$$

And,

$$Q_b = C_{u\ base} * N_c * A_b$$

Table 10 defines the parameters adopted for the above equations.

Table 10: Adopted parameters for preliminary pile calculations

Parameter		Adopted Value
Q_u	Ultimate resistance of pile	-
Q_s	Ultimate resistance of shaft	-
Q_b	Ultimate resistance of base	-
K_s	Coefficient of earth pressure on the pile shaft	Taken as 0.9 for CFA piles after Broms (1964)
P	Bulk density of soils	Submerged density of 10
Z	Depth	-

Parameter		Adopted Value
Φ	Phi Value	36 degrees
α	Adhesion Factor	0.45
$C_{u\ shaft}$	Average undrained shear strength of clay	Taken from C_u vs depth plot (Appendix H)
A_s	Embedded surface area of pile	-
$C_{u\ base}$	Undrained shear strength at the base of the pile	Taken from C_u vs depth plot (Appendix H)
N_c	Skempton"s bearing capacity factor	9
A_b	Area of pile base	-

An undrained shear strength against depth profile has been produced for the cohesive deposits, on the basis of the unconsolidated undrained triaxial tests undertaken. We have used a conservative line of best fit on this profile to determine $C_{u\ shaft}$ and $C_{u\ base}$ values to be adopted for the two pile options.

For the purpose of preliminary pile calculations we have assumed four strata to exist beneath the Made Ground, these strata are defined in Table 11 and are based on the ground conditions encountered at borehole BH1, which are considered to be the worst case condition.

Table 11: Adopted Design Parameters by Strata

Depth bgl, (m)	Stratum
0.90-6.00	Tidal Flat Deposit- Clays and peat
6.00-6.80	Tidal Flat Deposit – granular layer
6.80-9.50	Lowestoft Formation
9.50-14.00+	Kimmeridge Clay

We have determined safe working loads for 14m long bored piles of 300mm and 450mm diameter. Table 12 presents the calculated safe working loads for each of these pile scenarios, using the parameters and assumption previously defined.

Table 12: Safe working loads (kN) for bored piles

Pile Length (m)	Pile diameter (mm)	
	300	450
14	170	285

It should be appreciated that the safe working loads given above are indicative only and the specialist piling contractors should take responsibility for the design and performance of their piled foundations. It is recommended that each pile is integrity tested.

In the north-east corner of the site, in the vicinity of borehole BH2, the Tidal Flat Deposits are of reduced thickness and therefore the safe working loads for 14m long piles will be considerably higher. If additional site investigation is carried out in the north-east corner of the site to delineate the extent of the soft superficial deposits, it may be feasible to adopt reduced pile lengths in this area.

Specialist piling contractors should be consulted with regards to the design and performance of their foundations.

5.2. Ground Floor Construction

Given the susceptibility of the underlying soils to settlement when surcharged, we recommend that suspended ground floors are adopted on site.

A gas monitoring visit was carried out on 7 January 2015 and confirmed that the maximum carbon-dioxide concentration was 5.8% v/v at windowless sampler hole WS8 and the maximum flow rate recorded was 0.9l/hr.

Based on this initial set of data, the site would be classified as Characteristic Situation 2 in accordance with CIRIA C665, Assessing Risks Posed by Hazardous Ground Gases to Buildings (2007). For residential dwellings, mitigation measures would be as follows:

- Reinforced concrete cast in-situ floor slab (suspended, non-suspended or raft) with at least 1200g DPM and underfloor venting;

- Beam and block or pre-cast concrete and 2000g DPM/reinforced gas membrane and underfloor venting.

All joints and penetrations sealed.

On completion of the five remaining gas monitoring visits, the recommendations for mitigation measures will be reviewed and will be presented in an addendum to the report.

BRE document „Radon Guidance on Protective Measures for New Buildings", 2007 indicates some parts of the 1km grid square in which the site is located are in bands of elevated radon potential. The maximum radon potential for these areas is 1-3 %. Either basic radon protection measures will need to be installed within structures at the site or a BR211 Radon Report should be obtained for the site. The BR 211 Radon Report will indicate whether basic protection or no protection is required at the site.

5.3. Groundworks

The stability of any Made Ground or granular/cohesive materials must not be relied upon in unsupported excavations.

Safe working conditions must be provided at all times where persons are required to work in excavations.

Heavy plant and stockpiles of materials should not be permitted close to the edges of open excavations.

Based on the observations made during fieldwork, groundwater is likely to be encountered in excavations for structures or services at shallow depth. Furthermore, the first round of gas monitoring has confirmed that elevated carbon-dioxide concentrations have been recorded in the five wells monitored and slightly depleted oxygen concentrations have been noted in wells installed in windowless sampler holes WS3 and WS8. In addition, a „bad eggs" malodour, possibly indicative of hydrogen sulphide, has been noted in the well installed at WS4. Therefore, it is recommended that all excavations should be monitored for gas concentrations in accordance with the requirements for working in confined spaces.

Further reference should be made to CIRIA Report No.97 „Trenching Practice".

It is understood that the levels of the site may change as part of the development and therefore it is possible that additional soil may be placed on the existing ground surface to raise levels. Given the compressible nature of the soft/very soft organic clays and peat layers found across much of the site, it is anticipated that excessive

settlements (immediate and long-term) will occur leading to potential problems with underground services and finished levels.

For instance, a surcharge of 20kN/m^2 due to 1m of fill placed at the surface at borehole BH1 is estimated to generate a minimum of 200mm of total settlement in the made ground and underlying Tidal Flat Deposits. This estimate is based on limited laboratory data so the actual minimum value could be higher. Where the peat layers are thicker than at borehole BH1, the total settlements will increase accordingly. In addition, the variability in the nature and thickness of the Tidal Flat Deposits will potentially lead to significant differential settlements across the site.

It is recommended that flexible surfaces and flexible services which can accommodate these types of movements are used, where possible, to avoid damage in the future and it is recommended that filling on site is avoided. If filling is required, a geogrid/mattress system should be incorporated in the construction to control differential settlement.

5.4. Road Pavements

Given the organic nature of the shallow Tidal Flat Deposits and the high water table on site it is recommended that a CBR value of 1% is adopted for preliminary design purposes. A CBR of 1% should also be used for made ground.

Exposed subgrades are likely to deteriorate rapidly on exposure to wet weather and should be shaped to shed water.

Sub-base should be placed as soon as possible to minimise the exposure of subgrade to adverse weather conditions.

The sub-grade should be proof-rolled prior to pavement construction and any soft/loose pockets revealed should be excavated and replaced with well-compacted granular fill placed in layers.

In order to improve the clay subgrade, lime treatment may be feasible subject to suitability of such a process being demonstrated. Specialist lime treatment contractors should be consulted regarding the feasibility of this technique.

The inclusion of a geogrid/geotextile material may be advantageous. Interim Advice Note 73/06 Revision 1 (2009) Design Guidance for Road Pavement Foundations (Draft HD25) should be consulted for guidance. It is recommended that specialist geotextile suppliers are consulted regarding possible mitigation measures.

5.5. Drainage

Although infiltration testing was not undertaken as part of this investigation, the generally cohesive nature of the underlying soils and the high water table indicates the likely low permeability of the geology and it is therefore considered that soakaway drainage at the site will not be effective.

Alternative methods of surface water disposal should be investigated.

5.6. Concrete Grade

Sulphate content and pH value determinations were carried out by both the chemical and geotechnical laboratories.

Sulphate contents determined by the geotechnical laboratory are reported in terms of SO_3/l and have been multiplied by a factor of 1.2 to be expressed in terms of SO_4/l.

Eighteen soil analyses were carried out in total and indicated that the water soluble sulphate concentration (2:1 water:soil extract) ranged from 0.016g/l to 2.1g/l. The soil pH values varied from 5.1- 11.1.

The three groundwater analyses indicated that the water sulphate concentrations varied from 640-1100mg/l and groundwater pH ranged between 7.2 and 7.4.

In accordance with BRE Special Digest 1 „Concrete in Aggressive Ground" 2005, a Design Sulphate Class of DS-3 is recommended for buried concrete. An Aggressive Chemical Environment for Concrete (ACEC) classification of AC- 5 should be adopted.

Chloride concentrations in groundwater varied between 260mg/l and 1300mg/l. The designers of the piled foundations and underground concrete structures should check if the measured chloride concentrations in groundwater will pose a risk to steel reinforcement and that adequate cover to steel reinforcement is provided to prevent deterioration of foundations in the long-term.

6. GEOENVIRONMENTAL ASSESSMENT

The purpose of this section is to provide an assessment of the contamination status of the site. To aid in this, twelve samples of soil have been analysed for the broad suite of contaminants as follows:

Arsenic	*pH*
Cadmium	*Total Sulphate*
Chromium	*Water Soluble Sulphate*
Copper	*Total Phenols*

Nickel	*Total Cyanide*
Lead	*Sulphide*
Mercury	*Speciated Polyaromatic Hydrocarbons (PAH)*
Selenium	*Organic Matter Content*
Zinc	*Total Petroleum Hydrocarbons (TPH)*

Four samples were also screened for Asbestos.

Three samples of groundwater, recovered from the standpipes installed in BH2, WS3 and WS6 were analysed for the above suite of contaminants.

The laboratory analysis was undertaken by Chemtest, a UKAS and MCerts accredited laboratory.

6.1. Reference Criteria

6.1.1. Soil

Screening values have been adopted for the site to reflect site-specific parameters such as intended end use and the Soil Organic Matter (SOM). Screening values have been adopted from EA publications or adapted and derived using Environment Agency approved methods and software.

It is understood that the site is to be developed for residential purposes, screening values specific to residential land use with plant uptake have therefore, been adopted.

A conservative SOM of 1% has been adopted.

Full details of the reference criteria used to derive the screening values, including the adopted values is provided in Appendix C. The adopted screening values are also summarised in Section 6.2.1.

6.1.2. Groundwater

Screening values have been adopted for the site to reflect the fact both the Tidal Flat Deposits; Lowestoft Formation and the Kimmeridge Clay Formation are classified as unproductive strata in terms of aquifer potential and are typically considered to have negligible significance for either river base flow or water supply.

The site is located in the Anglian river basin district. To apply these regulations with regards to surface water and groundwater it is considered appropriate to assess groundwater concentrations of contaminants against Threshold Values (TV) contained in Annex B of EA"s RBMP for the Gaywood River.

Groundwater concentrations of contaminants not found in Annex B can be assessed against The River Basin District Typology, Standards and Groundwater threshold values (Water Framework Directive) (England and Wales) Directions 2010, Water Supply (Water Quality) (England) Regulations (DWS) and WHO Petroleum Products in Drinking Water (WHO) /Guidelines for Drinking-water Quality 4th Edition (WHO DWG) - whichever threshold is lesser for the individual substances.

Full details of the reference criteria used to derive the screening values, including the adopted values is provided in Appendix D. The adopted screening values are also summarised in Section 6.2.2.

6.2. Discussion of Analysis Results

6.2.1. Soil

Results of the chemical analysis are presented in Appendix D and summarised in Table 13, below.

The Made Ground encountered in WS2 was noted to contain occasional fragments of Asbestos. A subsequent Asbestos Screen of WS2 0.25-0.30m recorded Cement material containing Chrysotile. WS2 0.25-0.90m was tested to determine Asbestos Containing Materials (ACM) and also recorded Cement material containing Chrysotile.

A further two Made Ground Samples were subject to an Asbestos Screen (BH1 0.50m and BH3 1.20-1.70m) with „No Asbestos Detected".

Table 13: Results of Chemical Analysis - Soil

Contaminant	No of Samples Tested	Screening Value (mg/kg)	Range of Concentrations (mg/kg)	No of samples exceeding screening value
Arsenic	12	32	15 - 380	1
Cadmium	12	10	<0.1 - 0.27	0
Chromium	12	3000	25 - 52	0
Copper	12	2330	9.7 - 290	0
Nickel	12	130	23 - 45	0
Lead	12	290	21 - 130	0
Selenium	12	350	<0.2	0
Mercury	12	170	<0.10 - 0.31	0
Zinc	12	3750	49 - 170	0
Benzo(a)pyrene	12	0.83	<0.1	0
Dibenz(a,h)anthracene	12	0.79	<0.1	0
Naphthalene	12	4.55	<0.1	0

Contaminant	No of Samples Tested	Screening Value (mg/kg)	Range of Concentrations (mg/kg)	No of samples exceeding screening value
Total Phenols	12	244	<0.3	0
TPH Aromatic C^5-C^7	12	93	<0.1	0
TPH Aromatic C^7-C^8	12	150	<0.1	0
TPH Aromatic C^8-C^{10}	12	51	<0.1	0
TPH Aromatic C^{10}-C^{12}	12	78	<1	0
TPH Aromatic C^{12}-C^{16}	12	140	<1	0
TPH Aromatic C^{16}-C^{21}	12	248	<1	0
TPH Aromatic C^{21}-C^{35}	12	888	<1	0
TPH Aliphatic C^5-C^6	12	142	<0.1	0
TPH Aliphatic C^6-C^8	12	373	<0.1	0
TPH Aliphatic C^8-C^{10}	12	99	<0.1	0
TPH Aliphatic C^{10}-C^{12}	12	487	<1	0
TPH Aliphatic C^{12}-C^{16}	12	2871	<1	0
TPH Aliphatic C^{16}-C^{35}	12	75000*	<1	0
Sulphide	12	250	1.1 - 5.2	0

*Although soils up to this value may not be harmful to human health, it should be noted that soils would be saturated at this value and remediation may still be necessary. Results will therefore, be reviewed on a case by case basis.

From the above it is evident that ACM is present in the Made Ground in the location of WS2. A single sample recovered from the Tidal Flat Deposits in WS3 at a depth of 0.60m to 0.70m presents an elevated concentration of Arsenic.

6.2.2. Groundwater

Results of the chemical analysis of groundwater are presented in Appendix D and summarised in Table 14.

No visual or olfactory evidence of contamination was noted during development and groundwater sampling of boreholes.

Table 14: Results of Chemical Analysis - Groundwater

Contaminant	No of Samples Tested	Screening Value (ug/l unless otherwise stated)	Range of Concentrations (ug/l unless otherwise stated)	No of samples exceeding screening value
Arsenic	3	51.6	2.8 - 10	0
Cadmium	3	0.2	<0.08	0
Chromium	3	5	4.8 - 9.9	2

Contaminant	No of Samples Tested	Screening Value (ug/l unless otherwise stated)	Range of Concentrations (ug/l unless otherwise stated)	No of samples exceeding screening value
Copper	3	10.1	1.3 – 3.4	0
Nickel	3	20	1.2 - 15	0
Lead	3	7.3	<1	0
Selenium	3	10	5.3 - 11	1
Mercury	3	0.05	<0.5	0
Zinc	3	75.8	15 - 31	0
Naphthalene	3	2.4	<0.1	0
Benzo(a)pyrene	3	0.05	<0.1	0
Total PAH	3	0.1	<0.2	0
Total Phenols (mg/l)	3	0.0152	<0.03	0
Total TPH	3	10	<10	0

Chromium exceeds the minimum TV for groundwater impacts on surface water screening value but falls below the Water Supply (Water Quality) screening value of 50ug/l, indicating this substance does not need to be considered further.

The fact a minimum TV for groundwater impacts on surface water screening value is not available for Selenium (exceeds Water Supply (Water Quality) screening value) indicates this substance does not need to be considered further.

6.3. Risk Assessment

6.3.1. Revised Conceptual Model – Soil

As detailed in the preceding section, ACM and an elevated concentration of Arsenic have been detected in the soils beneath the site.

On the basis of these findings, the conceptual model presented in Table 3 has been revised and is presented in Table 15.

Table 15: Revised Conceptual Model - Soil

Contaminant	Source	Pathway	Receptor
ACM	Made Ground	Inhalation	End Users, Site Workers, Maintenance Workers, General Public
Arsenic	Natural Ground	Direct Contact, Ingestion, Inhalation	End Users, Site Workers, Maintenance Workers, General Public
		Direct Contact	Structures & Services
		Leaching	Controlled Waters

6.3.2. Soil Contamination & End Users

Considering initially end users of the site, exposure to contaminants would typically be through direct contact, ingestion or inhalation of contaminated soils where soil is exposed, such as in soft landscaping areas.

There is considered to be no risk beneath buildings or in paved areas as in such areas there is no pathway by which the pollutant linkage may be completed.

Remediation is considered necessary in soft landscaping areas around WS3 in which soil contamination has been identified.

It may be possible to reduce the area of the site which requires remediation, through further shallow soils investigations and associated chemical analysis in order that the area of identified contamination may be delineated.

At the concentration recorded to date it is recommended that a clean cover system of 600mm would be appropriate in any areas of soft landscaping, in line with guidance given in BRE 465 „Cover Systems for Land Regenerations" (2004) and subject to the approval of the Local Authority.

6.3.3. Soil Contamination & Construction Workers, Maintenance Workers and the Public

Risks to site workers and site neighbours during redevelopment are again primarily through dermal contact, ingestion or inhalation of contaminants. It is considered that the degree of contamination

observed poses a moderate / low risk to site workers, maintenance workers and the general public.

In order to reduce the risks to site workers during redevelopment safety measures should be adopted on site.

Workers should avoid contact with the soil by the use of protective boots, overalls and gloves, and should wash before eating, drinking and using the toilet.

To prevent inhalation of contaminants by site works and windblown transfer of contaminants off site, the generation of dust should be avoided, this may be achieved by spraying the materials with water if necessary. Measures should be taken to ensure that contaminated materials are not accidently transferred off site, for example on vehicle tyres.

Reference should be made to CIRIA Report No.132 "A Guide for Safe Working on Contaminated Sites", and Health & Safety Guidance Document "Protection of Works and General Public During the Development of Contaminated Lane" 1991.

6.3.4. Soil Contamination and Structures and Services

The elevated level of Arsenic contamination is considered to pose a risk to structures and services in the proposed development. It would be prudent to contact the water supply company regarding the necessity of the installation of any barrier pipes.

6.3.5. Soil Contamination and Controlled Waters

Whilst no leachate has been undertaken on the recovered soil samples, the risk posed by contamination to on and off-site drainage ditches is considered to be low on the basis of the following factors.

The site does not lie within a Source Protection Zone (SPZ) and there are no groundwater abstraction licences listed within 2km of the site.

The recorded natural geology in the locations of the identified soil contamination typically comprised cohesive Tidal Flat deposits overlying granular Tidal Flats Deposits. The cohesive nature of the overlying strata indicates their low permeability and thus the potential for contaminant leaching or migration is considered to be negligible.

6.3.6. Revised Conceptual Model - Groundwater

Elevated Sulphate concentrations were encountered in the groundwater which are considered to pose a risk to proposed structures. This is discussed further in Section 5.4.

No other elevated contaminant concentrations were encountered in the groundwater and it is therefore considered that further analysis of groundwater or remediation will not be necessary.

6.4. Hazardous Ground Gases

Gas monitoring results have recorded carbon-dioxide levels up to 5.8% by volume with a maximum flow rate of 0.9 l/h. No methane was detected during monitoring.

Carbon-dioxide is a heavier gas than air, which affects the respiratory and central nervous systems. It can cause unconsciousness at concentrations of 5% by volume and death at concentrations of 10% to 15% by volume.

Table 8.5 of CIRIA Report 665 (2007) provides information on current UK practice with respect to gas control measures based upon a Gas Screening Value (GSV). A GSV is obtained by multiplying the maximum concentration of gas by the maximum flow rate.

A GSV of 0.0522 is therefore currently applicable. This typically corresponds to Characteristic Situation 1, however where carbon-dioxide levels exceed 5% by volume (% v/v), consideration should be given to the adoption of a Characteristic Situation 2, which is recommended for adoption as a precautionary measure at the site.

A Characteristic Situation 2, requires that all joints and penetrations are sealed, underfloor venting is provided and a gas resistant membrane installed. Where cast in-situ floor slabs are used as 1200g membrane will be required, where pre-cast or beam and block construction is adopted a 2000g membrane will be required.

It should be noted that gas monitoring is on-going and the above will be reviewed on completion of the full monitoring regime.

Further assessment of Radon gas risk or incorporation Radon gas protection measures into the development is required as discussed in Section 3.3.

6.5. Waste Disposal

Waste will be generated from excavation works. There may be limited opportunities for re-use of materials on site however it is likely some waste will be disposed of off-site.

Waste removed from the site must be classified according to the analytical methods and criteria recommended by the Landfill (England and Wales) (Amendment) Regulations 2004 and 2005. The regulations

set new acceptance criteria for wastes to be disposed of at landfill sites with effect from 16th July 2005.

It is recommended that Waste Acceptance Criteria (WAC) testing is performed to assess the disposal characteristics of any soils to be removed from site and to ensure all wastes are correctly dealt with.

Full and detailed records should be kept of all waste soils removed from site for future reference purposes.

6.6. General

As with any sampling exercise, the sampling process is representative and it is possible that areas of contamination may be found during the redevelopment of the site. Excavations on site should be supervised and any areas of suspected contamination should be assessed by a competent professional and subject to further analysis if necessary.

It should be noted that all remediation proposals are subject to the approval of the Local Authority. It would be prudent to involve the regulatory bodies early in the development of the proposed scheme and before construction commences in order that all requirements are met.

7. FURTHER WORKS

It would be prudent to undertake further intrusive investigations and associated analysis to ensure appropriate coverage of the site is achieved. In particular, the area of possible filled ground at the east end of the site, which could not be investigated due to the presence of Japanese Knotweed, should be investigated.

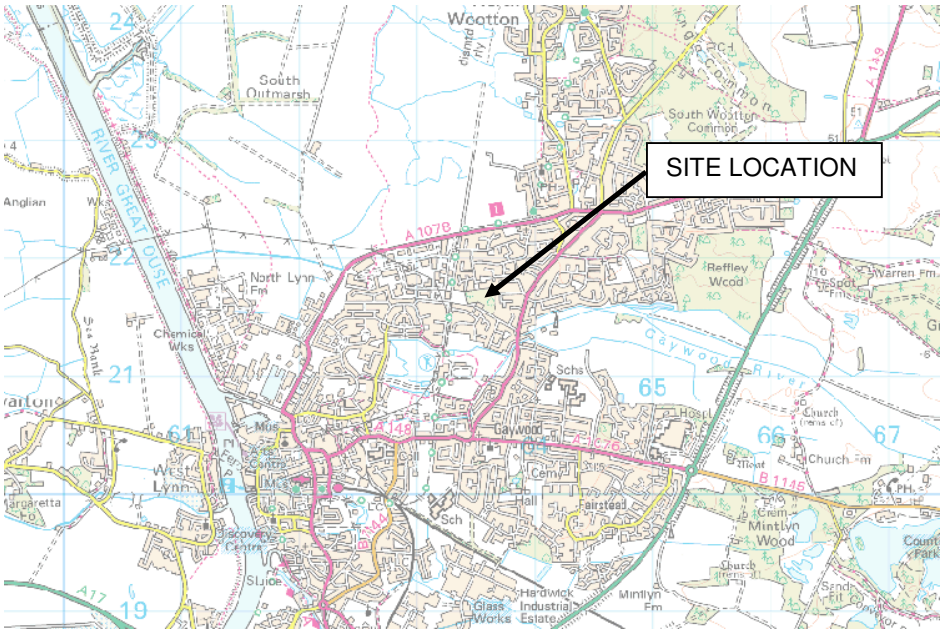
Further to the anecdotal information which became available during the desk study relating to the use of part of the site as a piggery and the possibility that animal carcasses may be buried at the site, further intrusive work to check for buried animal remains is also recommended. It is recommended that these investigations are undertaken prior to the commencement of construction on-site.

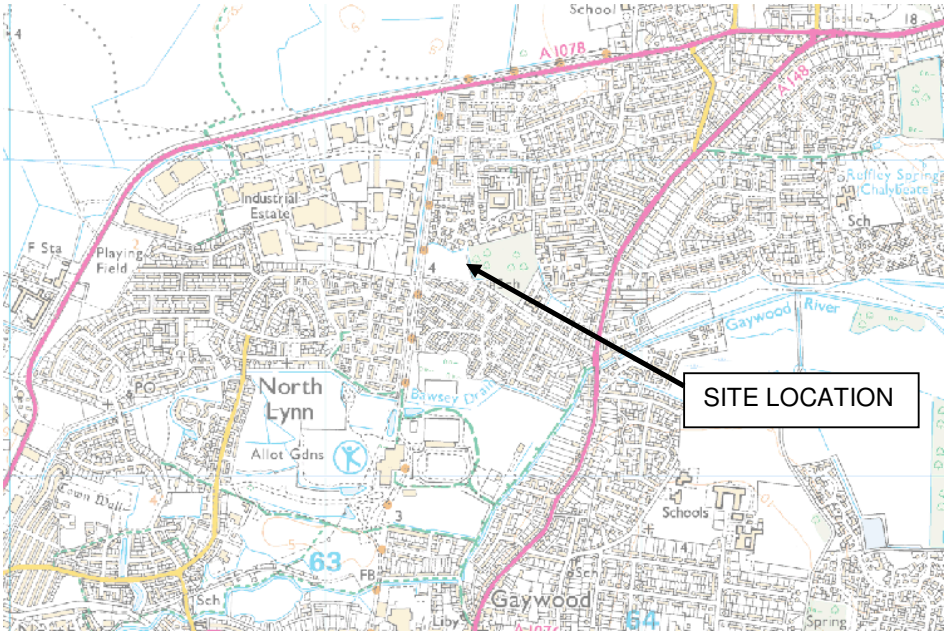
Gas monitoring at the site is on-going and the associated recommendations shall be reviewed on completion of the current regime.

Further assessment of radon gas risk or the incorporation of radon gas protection measures into the development is required.

APPENDIX A

Site Location, Proposed Development & Exploratory Hole Location Plans





richardjackson engineering consultants
consulting civil and structural engineers
26 High Street, Hadleigh, Ipswich, Suffolk, IP7 5AP
Tel: 01473 825300 Fax: 01473 825350

Marsh Lane, King's Lynn

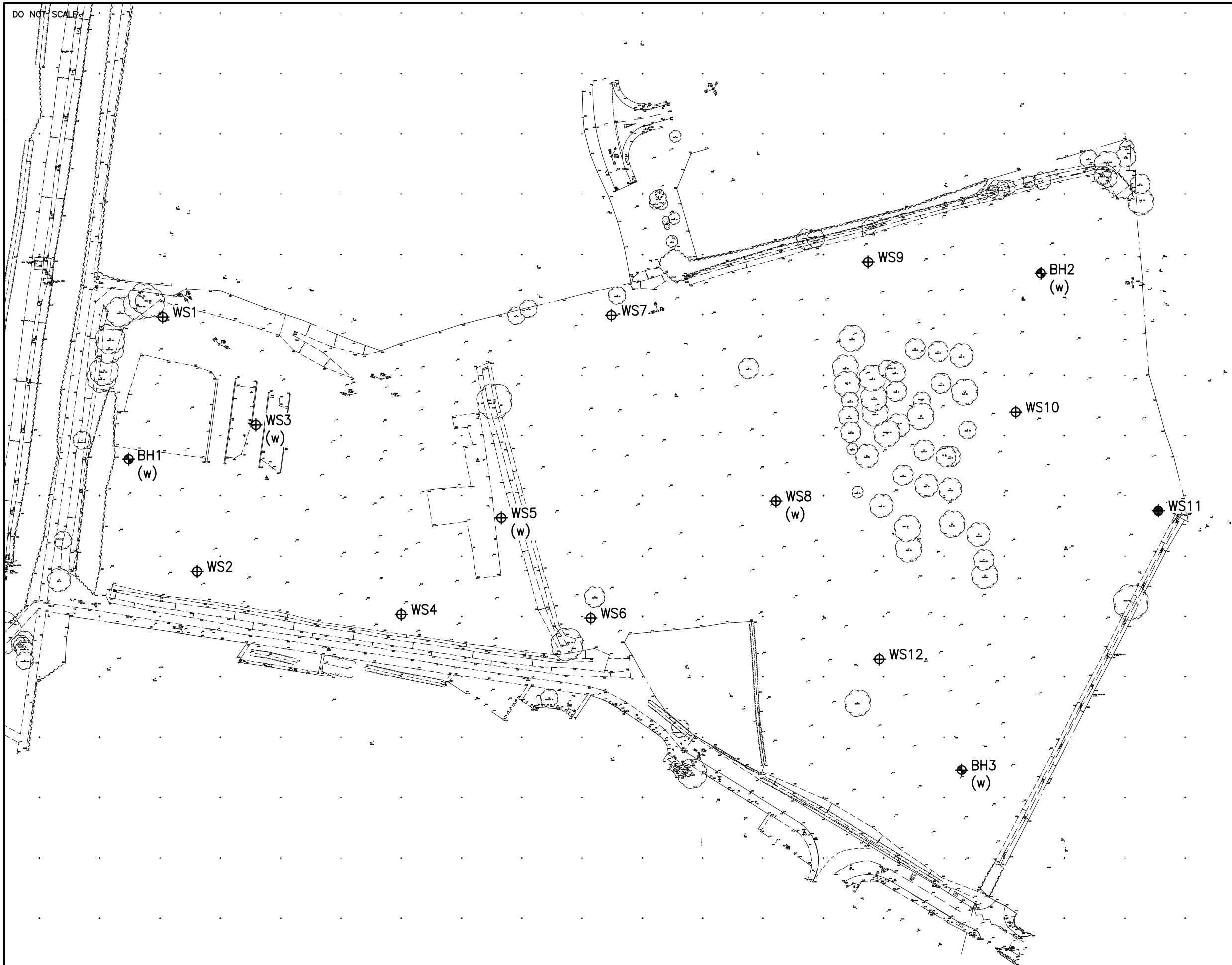
FIGURE 1

SITE LOCATION PLAN

SCALE: N.T.S.

JOB NO: 45751

DO NOT SCALE



- ⊕ WINDOWLESS SAMPLER BOREHOLE
- ⊕ LIGHT CABLE PERCUSSION BOREHOLE
- ● WS11 NOT DRILLED DUE TO PROXIMITY OF JAPANESE KNOTWEED
- (w)= GAS/GROUNDWATER MONITORING WELL INSTALLED.

REV	DATE	DESCRIPTION	DRAWN	CHKD

REVISIONS

This drawing is to be read in conjunction with all other Engineer's drawings and all other project information. Any discrepancy between the Engineer's drawings and other project information is to be reported to the Engineer immediately.

Project
MARSH LANE
KING'S LYNN
NORFOLK

Title
EXPLORATORY HOLE
LOCATION PLAN

Client
LOVELL PARTNERSHIP LTD

Scale	Drawn	Date
1:1250 @ A3	RDL	JANUARY 2015
Job Manager	Checked	Approved
S. HOLDER	D. WALL	

richardjackson engineering consultants

26 High Street, Hadleigh, Ipswich, Suffolk IP7 5AP Tel: 01473 825300 ☒
Suite 409, 1 Alie Street, London E1 8DE Tel: 020 7448 9910 ☐
York House, 3 Station Court, Station Rd, Great Shelford, Cambs CB22 5NE Tel: 01223 314794 ☐
6 The Old Church, St. Matthews Road, Norwich, Norfolk NR1 1SP Tel: 01603 230240 ☐
The Wheelhouse, Bonds Mill, Stonehouse, Gloucestershire GL10 3RF Tel: 01172 020070 ☐
Email Address: mail@rj.uk.com Web Site: http://www.richardjackson.uk.com

Drawing No.	Revision
45751B/G/FIG02	

Drawing Status
☒ INFORMATION ☐ APPROVAL ☐ COSTING
☐ TENDER ☐ CONSTRUCTION ☐ AS CONSTRUCTED

A3

REV	DATE	CHK	AMENDMENTS
A00	10.12.14	ESB	Initial Issue
A01	22.12.14	ABA	Site plan amended post updated below ground services
A02	09.01.15	ABA	Site plan amended post design review. Site s/w services removed / relocated, density increased at east site of site
A03	15.01.15	ABA	Site plan amended post Lovell review
A04	19.01.15	DD	Update to below ground constraints and easement zones, private road moved to align with highways adoption zone. Red line boundary djusted.

NOTES

Below ground services based on drawings 14966ea-01 to 07 Topographical Survey, dated 05/11/2014, and updated below ground information from Lovell dated 19/12/2014

Approximate location of Existing below ground Foul Water services

Approximate location of Existing below ground Surface Water services

Location of Proposed below ground Surface Water services

Existing Tree Removed

LOVELL

Feilden+Mawson

21-27 Lamb's Conduit Street London WC1N 3NL
1 Ferry Road Norwich NR1 1SU
50 St Andrews Street Cambridge CB2 3AH
email: info@feildenandmawson.com

tel: 020 7841 1980
tel: 01603 629571
tel: 01223 350567
www.feildenandmawson.com

CLIENT
Lovell

JOB
Marsh Lane Housing Development
King's Lynn

DRAWING
Site Plan

Preliminary

SCALE	1:500	PAPER	A1	DATE	Nov 2014
JOB	7956	DWG	003	REV	A04

DO NOT SCALE FROM THIS DRAWING ALL DIMENSIONS TO BE CONFIRMED ON SITE BY THE CONTRACTOR PRIOR TO CONSTRUCTION

I:\7956s 600 Homes Kings Lynn\K-Drawings\03-Current Drawings\AA-Master\01-Plan\003 Marsh Lane Site Plan.dwg /003/ISO full bleed A1 (841.00 x 594.00 MM)/David Drew/1/19/2015 9:50 AM

APPENDIX B

Borehole Logs

richardjackson engineering consultants
26 High Street
Hadleigh
Suffolk IP7 5AP
Tel: 01473825300
Fax: 01473825350

Borehole No **BH1** **Sheet 1 of 2**

Project Name: Marsh Lane	**Project No.** 45751 B	**Co-ords:** -	**Hole Type** Cable
Location: King's Lynn, Norfolk		**Level:** -	**Scale** 1:50
Client: Lovell Partnerships Ltd.		**Dates:** 07/01/2015	**Logged By** CG

Well	Water Strikes	Samples & In Situ Testing Depth (m)	Type	Results	Depth (m)	Legend	Stratum Description
		0.10	ES				MADE GROUND: Greyish brown slightly sandy silty CLAY with some gravel and occasional cobble-sized fragments of concrete and brick.
		0.30	D				
		0.50	ES				
		0.60	D		0.60		MADE GROUND: Grey clayey SAND GRAVEL of brick, concrete, sandstone, flint, limestone and occasional gravel-sized ash fragments.
		0.60-0.90	ES				
		0.90	D		0.90		Soft to firm (medium strength) slightly mottled orange and brown thinly laminated slightly sandy, silty CLAY.
		1.00	ES		1		
		1.10	D				
		1.20	U	50			
		1.60	D				
		1.80	D				...from 1.80m, grey.
		2.00-2.30	U	50	2.00		Yellowish brown and light olive brown very silty fine SAND with rare decayed roots.
		2.30	D		2.30		Soft brown gravelly CLAY with some dark grey degraded rootlets and slight organic odour.
		3.00	SPT	N=4	3		
		3.00	D	N=4 (0,1,1,1,1,1)			
		3.00-3.50	B				
		4.00-4.50	U	65	4.00		Firm (medium strength) black and dark-brown fibrous PEAT.
		4.50	D		4.40		Brown amorphous PEAT with some leaves and occasional wood and rootlets.
		5.00-5.50	U	65	5		
		5.50	D		5.30		Soft grey CLAY with occasional leaves and roots.
		5.70	D				...from 5.70m, greyish brown, organic rich pockets and some white shell fragments.
		6.50	SPT	N=55	6.00		Very dense brown clayey fine to medium SAND.
		6.50	D	N=55 (4,4,10,15,15,15)			
		6.50-7.00	B		6.80		Firm brown and grey slightly gravelly CLAY. Gravel fine to coarse, sub-angular to sub-rounded of chalk lithology.
		7.50	D		7		...from 7.50m, firm to stiff, slightly brown and grey.
		8.00-8.50	U	75	8		...at 8.00m, stiff (high strength) dark grey slightly gravelly, slightly sandy silty CLAY. Gravel is fine and medium chalk and filnt.
		8.50	D				
		9.00	D		9		...from 9.00m, stiff, gravelly CLAY. Gravel fine to medium, sub-angular to sub-rounded of mixed litholgy.
		9.50	SPT	N=28	9.50		Stiff to very stiff, dark grey, slightly friable, slightly gravelly, fissured CLAY with fine and medium gravel-sized
		9.50	D	N=28 (2,5,6,6,6,10)			
		9.50-10.00	B				
			Type	Results			

Remarks:

Sample Type/Test Key:
- U () U100 Sample (blows)
- D Disturbed Sample
- B Bulk Sample
- W Water Sample
- ▼ Ground Water Level

Penetration Tests
- S () Standard (N value)
- C () Cone (N value)
- * Blows and penetration when 300mm not achieved

AGS

richardjackson engineering consultants
26 High Street
Hadleigh
Suffolk IP7 5AP
Tel: 01473825300
Fax: 01473825350

Borehole No **BH1** **Sheet 2 of 2**

Project Name: Marsh Lane	**Project No.** 45751 B	**Co-ords:** -	**Hole Type** Cable
Location: King's Lynn, Norfolk		**Level:** -	**Scale** 1:50
Client: Lovell Partnerships Ltd.		**Dates:** 07/01/2015	**Logged By** CG

Well	Water Strikes	Samples & In Situ Testing Depth (m)	Type	Results	Depth (m)	Legend	Stratum Description
							mudstone and shell fragments.
		10.50	D				
		11.00-11.30	U	75	11		
		11.30	D				
		12.00	D		12		
		12.50	SPT	N=27			
		12.00-13.00	B	N=27 (3,3,6,7,7,7)			
		12.50	D		13		
		13.50	D				
					14		
		14.20-14.60	U	75			...at 14.20m, stiff (high strength) very dark grey CLAY with rare shell debris.
		14.60	D				
		15.00	D		15.00 15		End of Borehole at 15.00 m
					16		
					17		
					18		
					19		
			Type	Results			

Remarks:

Sample Type/Test Key:
- U () U100 Sample (blows)
- D Disturbed Sample
- B Bulk Sample
- W Water Sample
- ▼ Ground Water Level

Penetration Tests
- S () Standard (N value)
- C () Cone (N value)
- * Blows and penetration when 300mm not achieved

AGS

richardjackson engineering consultants
26 High Street
Hadleigh
Suffolk IP7 5AP
Tel: 01473825300
Fax: 01473825350

Borehole No **BH2** **Sheet 1 of 2**

Project Name: Marsh Lane	**Project No.** 45751 B	**Co-ords:** -	**Hole Type** Cable
Location: King's Lynn, Norfolk		**Level:** -	**Scale** 1:50
Client: Lovell Partnerships Ltd.		**Dates:** 19/12/2014	**Logged By** CG

Well	Water Strikes	Depth (m)	Type	Results	Depth (m)	Legend	Stratum Description
		0.10	D				TOPSOIL: Brown slightly sandy CLAY with roots and rootlets.
	▼	0.20	D		0.20		Firm mottled orange and brown silty CLAY with occasional rootlets.
		0.30-0.80	B				
		1.00	D		1.00		Medium dense brown slightly silty, slightly sandy medium to coarse GRAVEL. Gravel sub-angular to angular of mixed lithology.
	▽	1.20	SPT	N=19			
		1.20-1.70	B	N=19 (3,3,4,4,5,6)			
		1.90	D		1.90		Firm grey silty CLAY with pockets of brown sandy silt.
		2.00	SPT	N=12	2.00		Stiff to very stiff (very high strength) dark grey, slightly gravelly, slightly sandy, silty CLAY. Gravel is fine and medium chalk and rare flint.
		2.00-2.50	B	N=12 (1,1,2,3,3,4)			
		2.45	D				
		3.00-3.40	U	35			...at 3.00m, stiff (high strength) dark grey slightly gravelly, slightly sandy, silty CLAY. Gravel is fine and medium chalk and rare flint.
		3.50	D				...from 3.50m, firm to stiff, slightly gravelly.
		4.00	SPT	N=16			
		4.00-4.50	B	N=16 (1,2,3,3,5,5)			
		4.45	D				
		5.00-5.40	U	40			
		5.50	D				
		6.00	D				
		6.50	SPT	N=23			
		6.50-7.00	B	N=23 (2,3,5,5,6,7)			
		6.95	D				
		7.50	D				
		8.00-8.40	U	55			...at 8.00m, very stiff (very high strength) dark grey slightly gravelly, slightly sandy silty CLAY. Gravel is fine to coarse chalk and rare flint.
		8.50	D		8.50		Stiff slightly gravelly CLAY. Gravel fine to coarse, sub-angular to angular of chalk lithology.
		9.00	D				
		9.50	SPT	N=26			
		9.50-10.00	B	N=26 (3,3,5,6,7,8)			
		9.95	D				
		Type		Results			

Remarks: Groundwater standing at 0.29m bgl on 07/01/2015

Sample Type/Test Key:
U () U100 Sample (blows)
D Disturbed Sample
B Bulk Sample
W Water Sample
▼ Ground Water Level

Penetration Tests
S () Standard (N value)
C () Cone (N value)
* Blows and penetration when 300mm not achieved

AGS

richardjackson engineering consultants
26 High Street
Hadleigh
Suffolk IP7 5AP
Tel: 01473825300
Fax: 01473825350

Borehole No **BH2** **Sheet 2 of 2**

Project Name: Marsh Lane	**Project No.** 45751 B	**Co-ords:** -	**Hole Type** Cable
Location: King's Lynn, Norfolk		**Level:** -	**Scale** 1:50
Client: Lovell Partnerships Ltd.		**Dates:** 19/12/2014	**Logged By** CG

Well	Water Strikes	Samples & In Situ Testing Depth (m)	Type	Results	Depth (m)	Legend	Stratum Description
							Stiff slightly gravelly CLAY. Gravel fine to coarse, sub-angular to angular of chalk lithology.
		10.50	D		10.50		
							Stiff dark greyish brown fissured CLAY with occasional dark olive grey.
					11		
		11.00-11.40	U	55			...at 11.00m, stiff (high strength) dark grey fissured CLAY.
		11.50	D				
		12.00	D		12		
		12.50	SPT	N=38			
		12.50-13.00	B	N=38 (4,4,8,8,10,12)			
		12.95	D		12.95		
					13		Very weak to weak fissile thinly laminated MUDSTONE with traces of white degraded shell fragments.
					13.50		
		13.50-13.90	U	70			Stiff (high strength) fissured dark grey CLAY with occasional shell debris.
		14.00	D		14.00		
					14		Very weak to weak fissile thinly laminated MUDSTONE with traces of white degraded shell fragments.
		14.50	SPT	N=32			
		14.50-15.00	B	N=32 (4,4,7,7,8,10)			
		14.95	D		15.00		
					15		End of Borehole at 15.00 m
					16		
					17		
					18		
					19		
			Type	Results			

Remarks: Groundwater standing at 0.29m bgl on 07/01/2015

Sample Type/Test Key:
U () U100 Sample (blows)
D Disturbed Sample
B Bulk Sample
W Water Sample
▼ Ground Water Level

Penetration Tests
S () Standard (N value)
C () Cone (N value)
* Blows and penetration when 300mm not achieved

AGS

richardjackson engineering consultants
26 High Street
Hadleigh
Suffolk IP7 5AP
Tel: 01473825300
Fax: 01473825350

Borehole No **BH3** **Sheet 1 of 2**

Project Name: Marsh Lane	**Project No.** 45751 B	**Co-ords:** -	**Hole Type** Cable
Location: King's Lynn, Norfolk		**Level:** -	**Scale** 1:50
Client: Lovell Partnerships Ltd.		**Dates:** 22/12/2014	**Logged By** CG

Well	Water Strikes	Samples & In Situ Testing Depth (m)	Type	Results	Depth (m)	Legend	Stratum Description
		0.10	D		0.20		TOPSOIL
		0.20	D				MADE GROUND: Brown slightly gravelly CLAY, with occasional rootlets.
		0.30	B				
		0.30-0.60	ES				
	▼	1.00	D		1.20		
		1.20	CPT	N=10			MADE GROUND: Brown slightly silty clay with occasional pockets of brown amorphous peat and occasional brick fragments.
		1.20-1.70	B	N=10 (1,2,2,2,3,3)			
		1.20-1.70	ES				
		2.00	D		2.00		Soft brown peaty CLAY.
		2.10-2.40	U	12			
		2.40	D		2.40		Very soft slightly sandy slightly gravelly silty CLAY with pockets of fibrous organic material.
		2.50	CPT	9/225mm			
		2.50-2.70	B	225mm - Abandoned	2.70		Firm grey brown chalk, boulder CLAY (Driller's Description).
		2.90	D				
		3.00	U	25	3.10		Brown SAND and GRAVEL (Driller's Description).
		3.00-3.55	B				...water seepage at 3.10m.
		3.50	D		3.50		Stiff (high strength) dark grey, slightly chalky, gravelly, slightly sandy, silty CLAY with occasional olive mottling and rare selemite crystals. Gravel is fine and medium chalk.
		3.60-4.00	U	35			
		4.10	D				
		4.60	SPT	N=19			...from 4.60m, dark grey, slightly gravelly CLAY. Gravel fine to coarse sub-angular to angular of mixed lithology.
		4.60-5.10	B	N=19 (2,3,4,4,5,6)			
		5.05	D				
		5.60-6.00	U	40			...at 5.60m, with rare selenite crystals.
		6.10	D				
		6.60	D		6.60		Stiff grey thinly laminated CLAY with occasional traces of white shell fragment.
		7.10	SPT	N=33			...water seepage at 7.10m.
		7.10-7.60	B	N=33 (3,3,7,8,8,10)			
		7.55	D				...from 7.55m, dark grey, fissile.
	▽	8.10	D		8.10		Weak to very weak dark grey thinly laminated SHALE with some traces of white shell fragments.
		8.20	CPT	70/225mm			
		8.20-8.60	B	225mm (10,10,20,25,25)			
		9.20	D				
		9.70	CPT	59/210mm			
		9.70-10.10	B	210mm (5,6,9,25,25)			
		Type		Results			

Remarks: Groundwater standing at 0.94m bgl on 07/01/2015

Sample Type/Test Key:
U () U100 Sample (blows)
D Disturbed Sample
B Bulk Sample
W Water Sample
▼ Ground Water Level

Penetration Tests
S () Standard (N value)
C () Cone (N value)
* Blows and penetration when 300mm not achieved

AGS

richardjackson engineering consultants
26 High Street
Hadleigh
Suffolk IP7 5AP
Tel: 01473825300
Fax: 01473825350

Borehole No **BH3** **Sheet 2 of 2**

Project Name: Marsh Lane	**Project No.** 45751 B	**Co-ords:** -	**Hole Type** Cable
Location: King's Lynn, Norfolk		**Level:** -	**Scale** 1:50
Client: Lovell Partnerships Ltd.		**Dates:** 22/12/2014	**Logged By** CG

Well	Water Strikes	Samples & In Situ Testing Depth (m)	Type	Results	Depth (m)	Legend	Stratum Description
							Remaining Detail : 9.70m - 9.70m : ...from 9.70m, slightly friable.
		10.70	D		10.70		
		10.80-11.20	U	70			Stiff (high strength) fissured dark grey CLAY with some traces of white shell fragments.
					11		...from 11.30m, dark grey.
							...from 11.80m, very stiff, fissile, thinly laminated.
					12		
		12.30	SPT	N=41			
		12.30-12.80	B	N=41 (7,7,9,10,10,12)			
					13		...from 12.75m, stiff, grey, occasional traces of shell fragments.
					13.30		Stiff (high strength) fissured dark grey CLAY.
		13.80-14.20	U	70	14		
		14.50	SPT	N=47			
		14.50-15.00	B	N=47 (7,8,10,11,12,14)			
					15.00		End of Borehole at 15.00 m
					16		
					17		
					18		
					19		
			Type	Results			

Remarks: Groundwater standing at 0.94m bgl on 07/01/2015

Sample Type/Test Key:
U () U100 Sample (blows)
D Disturbed Sample
B Bulk Sample
W Water Sample
▼ Ground Water Level

Penetration Tests
S () Standard (N value)
C () Cone (N value)
* Blows and penetration when 300mm not achieved

AGS

richardjackson engineering consultants
26 High Street
Hadleigh
Suffolk IP7 5AP
Tel: 01473825300
Fax: 01473825350

Borehole No WS1
Sheet 1 of 1

Project Name: Marsh Lane
Project No. 45751 B
Co-ords: -
Hole Type WS

Location: King's Lynn, Norfolk
Ground Level (m AOD): -
Scale 1:25

Client: Lovell Partnerships Ltd.
Dates: 17/12/2014
Logged By DW

Water Strikes	Samples & In Situ Testing Depth (m)	Type	Results	Depth (m)		Legend	Stratum Description
				0.05			MADE GROUND: Firm dark brown slightly sandy, silty CLAY with occasional tree roots. ...80% recovery between 0.00m-1.00m.
							MADE GROUND: Stiff brown silty, sandy CLAY with a pocket of dark brown / orange brown fine to coarse sandy mudstone gravel between 0.55-0.65m.
				0.65			
	0.70-0.80	D 1					MADE GROUND: Stiff brown slightly sandy, gravelly CLAY with pockets of black ash between 0.65-0.75m.
				1.00	1.00		Very stiff brown sandy, silty CLAY with light brown silty fine sand laminations. ...95% recovery between 1.00m-2.00m.
	1.35-1.45	D 2					...at 1.35m, with occasional roots
	1.45-1.85	B 1					
				1.85			Stiff dark orange brown mottled brown and light grey silty, sandy CLAY with occasional fine tree roots.
				2.00	2.00		Brown mottled light grey sandy, silty CLAY with pockets / lenses of light brown silty fine sand. ...95% recovery between 2.00m-3.00m.
				3.00	3.00		Firm grey mottled brown slightly sandy, silty CLAY. ...100% recovery between 3.00m-4.00m.
				3.40			Becoming soft grey mottled dark blue organic silty CLAY.
	3.50	IVN 1	30kN/m2				
	3.75	IVN 2	24kN/m2				
				3.90			Dark brown fibrous PEAT.
	4.00	CPT	N=7 N=7 (1,1,1,2,2,2)	4.00	4.00		End of Borehole at 4.00 m

Type Results

Remarks:

Sample Type/Test Key:
IVN () Hand Vane (kN/m²)
W Water Sample
D Disturbed Sample
▼ Ground Water Level
ppm PID Reading

Penetration Tests:
S () Standard (N value)
C () Cone (N value)
• Blows and penetration when 300mm not achieved

AGS

richardjackson engineering consultants
26 High Street
Hadleigh
Suffolk IP7 5AP
Tel: 01473825300
Fax: 01473825350

Borehole No WS2
Sheet 1 of 1

Project Name: Marsh Lane
Project No. 45751 B
Co-ords: -
Hole Type WS

Location: King's Lynn, Norfolk
Ground Level (m AOD): -
Scale 1:25

Client: Lovell Partnerships Ltd.
Dates: 17/12/2014
Logged By DW

Water Strikes	Samples & In Situ Testing Depth (m)	Type	Results	Depth (m)		Legend	Stratum Description
	0.25-0.30	D 1		0.30			MADE GROUND: Soft brown silty, sandy CLAY with frequent wood fragments, coarse gravel sized concrete and occasional coarse gravel sized asbestos fragments. ...75% recovery between 0.00m-1.00m. ...occasional fragments of suspected asbestos.
				0.55			MADE GROUND: Crushed red brick.
	0.55-0.75	D 2					MADE GROUND: Firm to stiff brown silty CLAY with frequent coarse gravel-sized brick fragments and occassional medium gravel-sized asbestos fragments.
	0.90	D 3		1.00	1.00		MADE GROUND: Stiff brown silty clay with frequent fine to coarse gravel-sized brick and ash fragments. ...100% recovery between 1.00m-2.00m.
				1.45			Firm brown mottled grey silty CLAY.
	1.80-2.00	D 4			2.00		...75% recovery between 2.00m-3.00m.
	2.40	IVN 1	64kN/m2				
				2.60			Becoming soft bluish grey mottled brown organic silty CLAY.
	2.90	IVN 2	34kN/m2				
	2.80-3.00	D 5		3.00	3.00		Soft to very soft brown mottled bluish grey organic silty CLAY with occasional small dark blue amorphous peat pockets. ...85% recovery between 3.00m-4.00m.
	3.20	IVN 3	28kN/m2				
	3.50	IVN 4	10kN/m2				
				3.65			Dark brown fibrous PEAT.
	4.00	CPT	N=5 N=5 (1,1,1,1,1,2)	4.00	4.00		End of Borehole at 4.00 m

Type	Results

Remarks:

Sample Type/Test Key:
IVN () Hand Vane (kN/m²)
W Water Sample
D Disturbed Sample
▼ Ground Water Level
ppm PID Reading

Penetration Tests:
S () Standard (N value)
C () Cone (N value)
* Blows and penetration when 300mm not achieved

AGS

richardjackson engineering consultants
26 High Street
Hadleigh
Suffolk IP7 5AP
Tel: 01473825300
Fax: 01473825350

Borehole No WS3
Sheet 1 of 1

Project Name: Marsh Lane
Project No. 45751 B
Co-ords: -
Hole Type WS

Location: King's Lynn, Norfolk
Ground Level (m AOD): -
Scale 1:25

Client: Lovell Partnerships Ltd.
Dates: 17/12/2014
Logged By DW

Water Strike	Samples & In Situ Testing Depth (m)	Type	Results	Depth (m)		Legend	Stratum Description
				0.15			MADE GROUND: Firm brown to dark brown slightly sandy, silty friable CLAY with a trace of black ash and fine grass roots. ...100% recovery between 0.00m-1.00m.
	0.60-0.75	D 1					Firm brown slightly sandy, silty CLAY with occassional fine grass and vegetation roots.
	0.90-1.00	D 2		1.00	1.00		Firm to soft brown mottled grey brown slightly sandy, silty CLAY with occasional organic fibres. ...95% reocvery between 1.00m-2.00m.
	1.25	IVN 1	20kN/m2				
	1.80	IVN 2	36kN/m2				
				2.00	2.00		No recovery.
				2.55			Firm to stiff brown with a little grey mottling silty CLAY. ...45% recovery between 2.00m-3.00m.
	2.80-3.00	D 3					
				3.00	3.00		
				3.05			Firm to stiff brown with a little grey mottling silty CLAY. ...100% recovery between 3.00m-4.00m.
	3.15	IVN 3	18kN/m2				Soft / very soft dark brown mottled bluish grey organic silty CLAY.
	3.45	IVN 4	17kN/m2				
				3.60			
	3.65	IVN 5	6kN/m2				Firm brown fibrous PEAT with stems and root fibres visible.
	4.00	CPT	N=11 N=11 (1,1,2,2,3,4)	4.00	4.00		End of Borehole at 4.00 m
		Type	Results				

Remarks: Plain well pipe 0.62m bgl and 0.38m agl. Groundwater standing at 1.34m bgl on 14/12/14 and 1.26m bgl on 07/01/2015

Sample Type/Test Key:
IVN () Hand Vane (kN/m²)
W Water Sample
D Disturbed Sample
▼ Ground Water Level
ppm PID Reading

Penetration Tests:
S () Standard (N value)
C () Cone (N value)
* Blows and penetration when 300mm not achieved

AGS

richardjackson engineering consultants
26 High Street
Hadleigh
Suffolk IP7 5AP
Tel: 01473825300
Fax: 01473825350

Borehole No WS4
Sheet 1 of 1

Project Name: Marsh Lane
Project No. 45751 B
Co-ords: -
Hole Type WS

Location: King's Lynn, Norfolk
Ground Level (m AOD): -
Scale 1:25

Client: Lovell Partnerships Ltd.
Dates: 17/12/2014
Logged By DW

Water Strikes	Samples & In Situ Testing: Depth (m)	Type	Results	Depth (m)	Legend	Stratum Description
						TOPSOIL: Firm brown silty, sandy CLAY with occassional grass roots / vegetation roots.
				0.25		...25% recovery between 0.00m-1.00m.
						No recovery between 1.00m-2.00m.
				1.00		...no recovery between 1.00m-2.00m (cobble pushed ahead of sampler).
				2.00		No recovery between 2.00m-3.00m. 70% recovery between 3.00m-4.00m.
				3.00		...70% recovery between 3.00m-4.00m.
				3.30		Very soft grey mottled brown silty CLAY.
				3.40		Soft brown amorphous PEAT with a bad egg odour.
				4.00	4.00	End of Borehole at 4.00 m

Remarks:

Type Results

Sample Type/Test Key:
IVN () Hand Vane (kN/m²)
W Water Sample
D Disturbed Sample
▼ Ground Water Level
ppm PID Reading

Penetration Tests:
S () Standard (N value)
C () Cone (N value)
* Blows and penetration when 300mm not achieved

AGS

richardjackson engineering consultants
26 High Street
Hadleigh
Suffolk IP7 5AP
Tel: 01473825300
Fax: 01473825350

Borehole No WS5
Sheet 1 of 1

Project Name: Marsh Lane
Project No. 45751 B
Co-ords: -
Hole Type WS

Location: King's Lynn, Norfolk
Ground Level (m AOD): -
Scale 1:25

Client: Lovell Partnerships Ltd.
Dates: 17/12/2014
Logged By DW

Water Strike	Samples & In Situ Testing: Depth (m)	Type	Results	Depth (m)	Legend	Stratum Description
				0.10		TOPSOIL: Dark brown slightly sandy, silty CLAY with occasional grass roots ...70% recovery between 0.00m-1.00m.
	0.80-1.00	D 1		1.00	1.00	Firm to stiff brown slightly sandy, silty CLAY with occasional fine roots and occasional black organic fibres at 0.90m.
	1.20	IVN 1	54kN/m2			Firm brown silty CLAY. ...100% recovery between 1.00m-2.00m.
	1.55 1.50-1.70	IVN 2 D 2	48kN/m2	1.40		Firm brown mottled grey silty CLAY.
	1.90	IVN 3	68kN/m2	2.00	2.00	
	2.35	IVN 4	26kN/m2	2.20		Soft brown mottled grey silty CLAY. ...80% recovery between 2.00m-3.00m.
	2.55	IVN 5	35kN/m2	2.60		Dark brown fibrous PEAT.
				3.00	3.00	
				3.30		Soft dark brown fibrous PEAT becoming soft clayey amorphous PEAT below 3.80m. ...70% recovery between 3.00m-4.00m.
	3.90-4.00	D 3		3.90		Soft brown silty, sandy slightly gravelly CLAY.
				4.00	4.00	End of Borehole at 4.00 m

Type Results

Remarks: Plain well pipe 0.60m bgl and 0.40m agl. Groundwater standing at 0.97m bgl on 14/12/14 and 0.80m bgl on 07/01/2015.

Sample Type/Test Key:
IVN () Hand Vane (kN/m²)
W Water Sample
D Disturbed Sample
▼ Ground Water Level
ppm PID Reading

Penetration Tests:
S () Standard (N value)
C () Cone (N value)
* Blows and penetration when 300mm not achieved

AGS

richardjackson engineering consultants
26 High Street
Hadleigh
Suffolk IP7 5AP
Tel: 01473825300
Fax: 01473825350

Borehole No WS6
Sheet 1 of 1

Project Name: Marsh Lane
Project No. 45751 B
Co-ords: -
Hole Type WS

Location: King's Lynn, Norfolk
Ground Level: - (m AOD)
Scale 1:25

Client: Lovell Partnerships Ltd.
Dates: 16/12/2014
Logged By DW

Water Strikes	Samples & In Situ Testing Depth (m)	Type	Results	Depth (m)		Legend	Stratum Description
							MADE GROUND: Firm brown silty CLAY with occasional fine grass root fibres and a coarse gravel-sized brick fragments at 0.50m.
	0.25-0.45	D 1					...100% recovery between 0.00m-1.00m.
				0.60			Stiff brown mottled grey silty CLAY with occasional decayed roots at 0.90m.
	0.90-1.00	B 1					
	1.00	IVN 1	98kN/m2	1.00	1.00		Firm brown mottled grey silty CLAY.
							...90% recovery between 1.00m-2.00m.
	1.25	IVN 2	50kN/m2				
				1.55			Dark brown fibrous PEAT containing brown stems and fibres.
				2.00	2.00		
				2.50			Dark brown fibrous PEAT.
							...50% recovery between 2.00m-3.00m.
				3.00	3.00		
				3.40			PEAT
				3.50			...60% recovery between 3.00m-4.00m.
							Soft grey organic silty CLAY with occasional small organic fibres and peat pockets.
	3.80-4.00	D 2					...becoming soft dark grey silty CLAY with bands of grey silty fine sand at 3.80m.
	4.00	CPT	N=11 N=11 (1,1,2,2,3,4)	4.00	4.00		End of Borehole at 4.00 m

Type Results

Remarks:

Sample Type/Test Key:
IVN () Hand Vane (kN/m²)
W Water Sample
D Disturbed Sample
▼ Ground Water Level
ppm PID Reading

Penetration Tests:
S () Standard (N value)
C () Cone (N value)
* Blows and penetration when 300mm not achieved

AGS

richardjackson engineering consultants
26 High Street
Hadleigh
Suffolk IP7 5AP
Tel: 01473825300
Fax: 01473825350

Borehole No WS7
Sheet 1 of 1

Project Name: Marsh Lane
Project No. 45751 B
Co-ords: -
Hole Type WS

Location: King's Lynn, Norfolk
Ground Level (m AOD): -
Scale 1:25

Client: Lovell Partnerships Ltd.
Dates: 16/12/2014
Logged By DW

Water Strikes	Samples & In Situ Testing Depth (m)	Type	Results	Depth (m)		Legend	Stratum Description
							MADE GROUND: Firm brown slightly sandy, silty CLAY with occasional tree and vegetation roots and occasional brick fragments at 0.35m and a trace of angular fine to medium flint gravel. ...100% recovery between 0.00m-1.00m.
	0.90-1.00	D 1					
	1.00	CPT	N=6 N=6 (1,1,1,2,1,2)	1.00	1.00		
	1.00-1.45	B 1					Firm brown becoming orange brown mottled light grey slightly sandy, silty CLAY with occasional roots. ...80% recovery between 1.00m-2.00m.
				2.00	2.00		No recovery 2.00m-3.00m.
	3.00	CPT	N=4 N=4 (1,1,1,1,1,1)	3.00	3.00		60% recovery 3.00m-4.00m.
				3.40			Soft to very soft brown silty CLAY.
	3.55	IVN 1	14kN/m2				
	3.60-4.00	B 2		3.80			Becoming very soft dark blue organic silty CLAY with a trace of fibrous peat pockets at 3.95m.
	3.85	IVN 2	10kN/m2				
				4.00	4.00		End of Borehole at 4.00 m

Type	Results

Remarks:

Sample Type/Test Key:
IVN () Hand Vane (kN/m²)
W Water Sample
D Disturbed Sample
▼ Ground Water Level
ppm PID Reading

Penetration Tests:
S () Standard (N value)
C () Cone (N value)
* Blows and penetration when 300mm not achieved

AGS

richardjackson engineering consultants
26 High Street
Hadleigh
Suffolk IP7 5AP
Tel: 01473825300
Fax: 01473825350

Borehole No WS8
Sheet 1 of 1

Project Name: Marsh Lane
Project No. 45751 B
Co-ords: -
Hole Type WS

Location: King's Lynn, Norfolk
Ground Level (m AOD): -
Scale 1:25

Client: Lovell Partnerships Ltd.
Dates: 17/12/2014
Logged By DW

Water Strike	Samples & In Situ Testing Depth (m)	Type	Results	Depth (m)	Legend	Stratum Description
				0.10		TOPSOIL: Firm brown and grey silty CLAY with occasional grass roots. ...55% recovery between 0.00m-1.00m.
	0.45-0.55	D 1		0.55		Firm brown mottled light grey silty CLAY.
	1.10	IVN 1	85kN/m2	1.00	1.00	Stiff to firm brown mottled grey, silty CLAY with a trace of white selenite crystals. ...100% recovery between 1.00m-2.00m.
	1.40 1.40-1.50	IVN 2 D 2	54kN/m2	1.50		Firm dark brown fibrous PEAT.
				2.00	2.00	
				2.60		Very soft dark brown fibrous PEAT. ...40% recovery between 2.00m-3.00m.
				3.00	3.00	Very soft dark brown fibrous and amorphous and fibrous PEAT. ...100% recovery between 3.00m-4.00m.
				3.50		Soft grey mottled brown slightly sandy, silty CLAY.
	3.60	IVN 3	28kN/m2			
	3.80	IVN 4	34kN/m2			...at 3.80m becoming soft grey mottled brown slightly sandy, silty very gravelly CLAY with gravel comprising sub-angular to sub-rounded fine to medium chalk gravel.
				4.00	4.00	End of Borehole at 4.00 m

Type Results

Remarks: Plain well pipe 0.70m bgl and 0.26m agl. Groundwater standing at 0.10m bgl on 18/12/2014 and 0.01m bgl on 07/01/2015.

Sample Type/Test Key:
IVN () Hand Vane (kN/m²)
W Water Sample
D Disturbed Sample
▼ Ground Water Level
ppm PID Reading

Penetration Tests:
S () Standard (N value)
C () Cone (N value)
* Blows and penetration when 300mm not achieved

AGS

richardjackson engineering consultants
26 High Street
Hadleigh
Suffolk IP7 5AP
Tel: 01473825300
Fax: 01473825350

Borehole No WS9
Sheet 1 of 1

Project Name: Marsh Lane
Project No. 45751 B
Co-ords: -
Hole Type WS

Location: King's Lynn, Norfolk
Ground Level (m AOD): -
Scale 1:25

Client: Lovell Partnerships Ltd.
Dates: 16/12/2014
Logged By DW

Water Strikes	Samples & In Situ Testing Depth (m)	Type	Results	Depth (m)		Legend	Stratum Description
	0.00	IPP					MADE GROUND: Firm brown with a little grey slightly sandy, silty CLAY with red textile at 0.60m. ...80% recovery between 0.00m-1.00m.
	0.45-0.55	D 1					
				0.65			Stiff brown mottled grey silty CLAY with an occasional tree root at 0.95m.
	0.80-1.00	B 1					
				1.00	1.00		Stiff brown mottled grey silty CLAY with occasional fine tree roots. ...95% recovery between 1.00m-2.00m.
				1.70			Dark blue / brown wood to 1.75m becoming firm brown fibrous PEAT with frequent stems and fragments of vegetation.
				2.00	2.00		Firm brown fibrous PEAT with frequent stems and fragments of vegetation.
							...75% recovery between 2.00m-3.00m.
				2.65			Soft / very soft grey and brown silty, sandy gravelly CLAY / clayey SAND and GRAVEL.
	2.65-3.00	B 2					
				3.00	3.00		Brown silty, sandy organic fine to medium flint GRAVEL. ...60% recovery between 3.00m-4.00m.
				3.50			Stiff brown mottled grey slightly sandy, slightly gravelly silty CLAY with gravel comprising sub-angular fine to medium chalk fragments.
	3.50-4.00	B 3					
				4.00	4.00		End of Borehole at 4.00 m

Type Results

Remarks:

Sample Type/Test Key:
IVN () Hand Vane (kN/m²)
W Water Sample
D Disturbed Sample
▼ Ground Water Level
ppm PID Reading

Penetration Tests:
S () Standard (N value)
C () Cone (N value)
* Blows and penetration when 300mm not achieved

AGS

richardjackson engineering consultants
26 High Street
Hadleigh
Suffolk IP7 5AP
Tel: 01473825300
Fax: 01473825350

Borehole No WS10
Sheet 1 of 1

Project Name: Marsh Lane
Project No. 45751 B
Co-ords: -
Hole Type WS

Location: King's Lynn, Norfolk
Ground Level (m AOD): -
Scale 1:25

Client: Lovell Partnerships Ltd.
Dates: 17/12/2014
Logged By DW

Water Strikes	Samples & In Situ Testing Depth (m)	Type	Results	Depth (m)		Legend	Stratum Description
				0.15			TOPSOIL: Dark brown slightly sandy, silty CLAY with occasional grass roots. ...100% recovery between 0.00m-1.00m.
							Firm brown mottled orange brown silty CLAY.
	0.60-0.75	LB 1					
	0.80-1.00	B 1					
				1.00	1.00		Brown silty very gravelly fine to coarse SAND with gravel comprising angular to rounded fine to coarse flint. ...95% recovery between 1.00m-2.00m.
				1.85			Stiff grey mottled brown slightly gravelly silty CLAY with gravel comprising fine, sub-angular chalk fragments.
				2.00	2.00		SAND and GRAVEL (probably material which has collapsed in the hole) ...85% recovery between 2.00m-3.00m.
				2.50			Stiff brown mottled grey slightly gravelly silty CLAY with gravel comprising fine chalk.
				2.75			Brown silty fine to medium SAND.
				3.00	3.00		End of Borehole at 3.00 m
					4.00		
		Type	Results				

Remarks:

Sample Type/Test Key:
IVN () Hand Vane (kN/m²)
W Water Sample
D Disturbed Sample
▼ Ground Water Level
ppm PID Reading

Penetration Tests:
S () Standard (N value)
C () Cone (N value)
* Blows and penetration when 300mm not achieved

AGS

richardjackson engineering consultants
26 High Street
Hadleigh
Suffolk IP7 5AP
Tel: 01473825300
Fax: 01473825350

Borehole No WS12
Sheet 1 of 1

Project Name: Marsh Lane
Project No. 45751 B
Co-ords: -
Hole Type WS

Location: King's Lynn, Norfolk
Ground Level (m AOD): -
Scale 1:25

Client: Lovell Partnerships Ltd.
Dates: 16/12/2014
Logged By DW

Water Strikes	Samples & In Situ Testing Depth (m)	Type	Results	Depth (m)		Legend	Stratum Description
							MADE GROUND: Stiff dark brown silty CLAY with occasional black ash pockets and occasional tree roots. ...100 recovery between 0.00m-1.00m.
				0.30			Firm brown silty CLAY.
	0.80-1.00	D 1					
				1.00	1.00		Firm brown mottled grey silty CLAY. ...95% recovery between 1.00m-2.00m.
				1.25			Firm brown fibrous PEAT with frequent stems and organic material / fibres visible.
				1.80			Soft grey silty, sandy slightly gravelly CLAY with gravel comprising angular flint.
	1.90	IVN 1	10kN/m2				
	1.80-2.00	B 1		2.00	2.00		40% recovery between 2.00m-3.00m.
				2.60			Soft to firm bluish grey mottled brown silty, sandy slightly gravelly CLAY with gravel comprising fine gravel sized fragments. Clay contains occasional fine black organic fibres.
				3.00	3.00		50% recovery between 3.00m-4.00m.
				3.50			Soft grey silty sandy CLAY.
				3.65			Firm becoming stiff grey mottled brown slightly gravelly, silty CLAY with gravel comprising coarse gravel sized white chalk fragments.
	3.65-4.00	B 2					
				4.00	4.00		End of Borehole at 4.00 m

Type Results

Remarks:

Sample Type/Test Key:
IVN () Hand Vane (kN/m²)
W Water Sample
D Disturbed Sample
▼ Ground Water Level
ppm PID Reading

Penetration Tests:
S () Standard (N value)
C () Cone (N value)
* Blows and penetration when 300mm not achieved

AGS

APPENDIX C

Geotechnical Testing Results

TEST REPORT.

ISSUED BY : **SOIL PROPERTY TESTING LTD.**

DATE OF ISSUE : 16/01/15 **PAGE 1 of 38 Pages**

Contract Marsh Lane, Kings Lynn.

Serial No. S28408

UKAS TESTING 0998

CLIENT:

Richard Jackson Ltd
26 HIGH STREET
HADLEIGH
IPSWICH
SUFFOLK
IP7 5AP

Soil Property Testing

18 Halcyon Court, St Margarets Way,
Stukeley Meadows, Huntingdon,
Cambs. PE29 6DG.

Telephone (01480) 455579 Fax (01480) 453619
Email enquiries@soilpropertytesting.com

SAMPLES SUBMITTED BY:

Richard Jackson Ltd

APPROVED SIGNATORIES:

☑ **J.C.GARNER B.Eng (Hons.) FGS**
Technical Director

☐ **S.P.TOWNEND FGS**
Quality Manager

☐ **T.FOORD BSc (Hons.) FGS**
Site Services Manager

SAMPLES LABELLED:

Marsh Lane, Kings Lynn.

DATE RECEIVED: 24/12/14

SAMPLES TESTED BETWEEN 24/12/14 **and** 16/01/15

REMARKS: For the attention of Mr D Wall
Your Project No.: 45751

NOTES:

1 All remaining samples or remnants from this contract will be disposed of after 21 days from today, unless we are notified to the contrary.

2 (a) UKAS - United Kingdom Accreditation Service.
(b) Opinions and interpretations expressed herein are outside the scope of UKAS accreditation.

3 Tests marked "NOT UKAS ACCREDITED" in this test report are not included in the UKAS Accreditation Schedule for this testing laboratory.

4 This test report may not be reproduced other than in full except with the prior written approval of the issuing laboratory.

TEST REPORT.

ISSUED BY : SOIL PROPERTY TESTING LTD.

DATE OF ISSUE : As page 1 **PAGE** 2 of 38

Contract Marsh Lane, Kings Lynn.

Serial No. S28408

SCHEDULE OF LABORATORY TESTS

Bh./ Tp No.	Sample Ref	Depth (from)	1:Moisture Content Determination	4:Liquid/Plastic limit 1 point	13:Triaxial Test single stage	31:One Dimensional Consolidation	5:Wet Sieve Preparation for Limit	7:PSD by Wet Sieve BS1377	700:Sulphate Test (2:1 Water Soil	702:ph value of Soil or Water	Remarks
BH1	D3	0.90	*	*							
	U1	1.20			*						
	U2	2.00			*						
	U3	4.00			*						
	U4	5.00				*					
	U5	8.00			*						
	U6	11.00		*	*		*				
	U7	14.20			*						
BH2	B2	1.20						*			
	U1	3.00			*						
	U2	5.00			*						
	D8	5.50	*	*			*				
	U3	8.00			*						
	D13	9.00						*	*		
	U4	11.00			*						
	D16	11.50	*	*							
	U5	13.50			*						
BH3	D4	2.00	*	*							
	U3	3.60			*						
	U4	5.60			*						
	D13	8.10	*	*			*				
	D14	9.20						*	*		
	U5	10.80			*						
	U6	13.80			*						
WS1	D2	1.35	*	*							
WS6	D2	0.90	*	*							
WS7	D2	1.00	*	*							
WS9	B4	3.50	*	*			*				
WS12	B3	3.65	*	*			*				
-	-	-	10	11	15	1	5	1	2	2	<— Total Number of Tests ——

Scheduled by: Richard Jackson Ltd

Target Date: 16/01/15

TEST REPORT.

ISSUED BY : SOIL PROPERTY TESTING LTD.

DATE OF ISSUE : As page 1 **PAGE** 3 of 38

Contract Marsh Lane, Kings Lynn.

Serial No. S28408

UKAS TESTING 0998

SUMMARY OF MOISTURE CONTENT, LIQUID LIMIT, PLASTIC LIMIT, PLASTICITY INDEX AND LIQUIDITY INDEX

Borehole/ Pit No.	Depth m.	Sample	Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Liquidity Index (%)	SAMPLE PREPARATION Method S/N	Ret'd 0.425mm (%)	Corr'd M/C <0.425mm	Curing Time (hrs.)	Description	CLASS
BH1	0.90	D3	26	39	22	17	0.29*	N	3(A)	27	24	Firm brown slightly sandy silty CLAY with occasional light orangey brown mottling, concrete and brick fragments and rare decayed roots	CI
BH1	11.00	U6	32	59	35	24		S	43(M)		24	Very stiff (Very high strength) fissured friable dark grey CLAY with fine and medium angular and subangular mudstone fragments and shell debris	MH
BH2	5.50	D8	18	37	17	20	0.15*	S	9(M)	20	25	Stiff fissured dark grey slightly gravelly slightly sandy silty CLAY. Gravel is fine and medium chalk	CI
BH2	11.50	D16	24	62	25	37	-0.03	N			100	Stiff fissured dark greyish brown CLAY with occasional dark olive grey	CH
BH3	2.00	D4	53	85	36	49	0.35	N	0(A)		24	Soft brown CLAY	CV
BH3	8.10	D13	37	51	33	18		S	34(M)		24	Soft dark grey CLAY with claystone/mudstone fragments from fine to coarse gravel size and shell debris	MH
WS1	1.35 -1.45	D2	17	34	22	12	-0.42	N	0(A)		24	Very stiff friable yellowish brown silty CLAY with occasional recently active roots	CL
WS6	0.90 -1.00	D2	27	55	23	32	0.13	N	0(A)		24	Stiff dark yellowish brown CLAY with occasional bluish grey veins and decayed roots	CH
WS7	1.00 -1.45	D2	33	58	25	33	0.24	N	0(A)		24	Stiff dark yellowish brown CLAY with occasional recently active roots	CH

METHOD OF PREPARATION : BS 1377:PART 1:1990:7.4 & PART 2:1990:4.2 S = Wet Sieved Specimen N = prepared from Natural

METHOD OF TEST : BS 1377:PART 2:1990:3.2, 4.4, 5.3, 5.4

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter. A = Assumed, M = Measured

COMMENTS : Liquidity Index, *=calculated liquidity index assumes material greater than 0.425mm non porous. See BS1377:Part2:1990 Clause 3 Note 1.

REMARKS TO INCLUDE : Sample disturbance, loss of moisture, variation from test procedure, location and origin of test specimen within original sample. Oven drying temperature if not 105-110 deg C.

TEST REPORT.

ISSUED BY : SOIL PROPERTY TESTING LTD.

DATE OF ISSUE : As page 1 **PAGE** 4 of 38

Contract Marsh Lane, Kings Lynn.

Serial No. S28408

UKAS TESTING 0998

SUMMARY OF MOISTURE CONTENT, LIQUID LIMIT, PLASTIC LIMIT, PLASTICITY INDEX AND LIQUIDITY INDEX

Borehole/ Pit No.	Depth m.	Sample	Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plast-icity Index (%)	Liqu-idity Index (%)	SAMPLE PREPARATION				Description	CLASS
								Method S/N	Ret'd 0.425mm (%)	Corr'd M/C <0.425mm	Curing Time (hrs.)		
WS9	3.50	B4	22	39	18	21	0.29*	S	7(M)	24	24	Firm grey and light olive brown slightly gravelly slightly sandy silty CLAY with occasional dark grey and yellowish brown mottling and rare decayed roots. Gravel is fine and medium rounded to subangular chalk	CI
WS12	3.65	B3	25	48	22	26	0.19*	S	8(M)	27	25	Firm dark grey and olive grey slightly gravelly slightly sandy silty CLAY with occasional olive mottling and rare decayed roots. Gravel is fine and medium subrounded and subangular chalk	CI

METHOD OF PREPARATION : BS 1377:PART 1:1990:7.4 & PART 2:1990:4.2 S = Wet Sieved Specimen N = prepared from Natural

METHOD OF TEST : BS 1377:PART 2:1990:3.2, 4.4, 5.3, 5.4

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter. A = Assumed, M = Measured

COMMENTS :

REMARKS TO INCLUDE : Sample disturbance, loss of moisture, variation from test procedure, location and origin of test specimen within original sample. Oven drying temperature if not 105-110 deg C.

TEST REPORT.

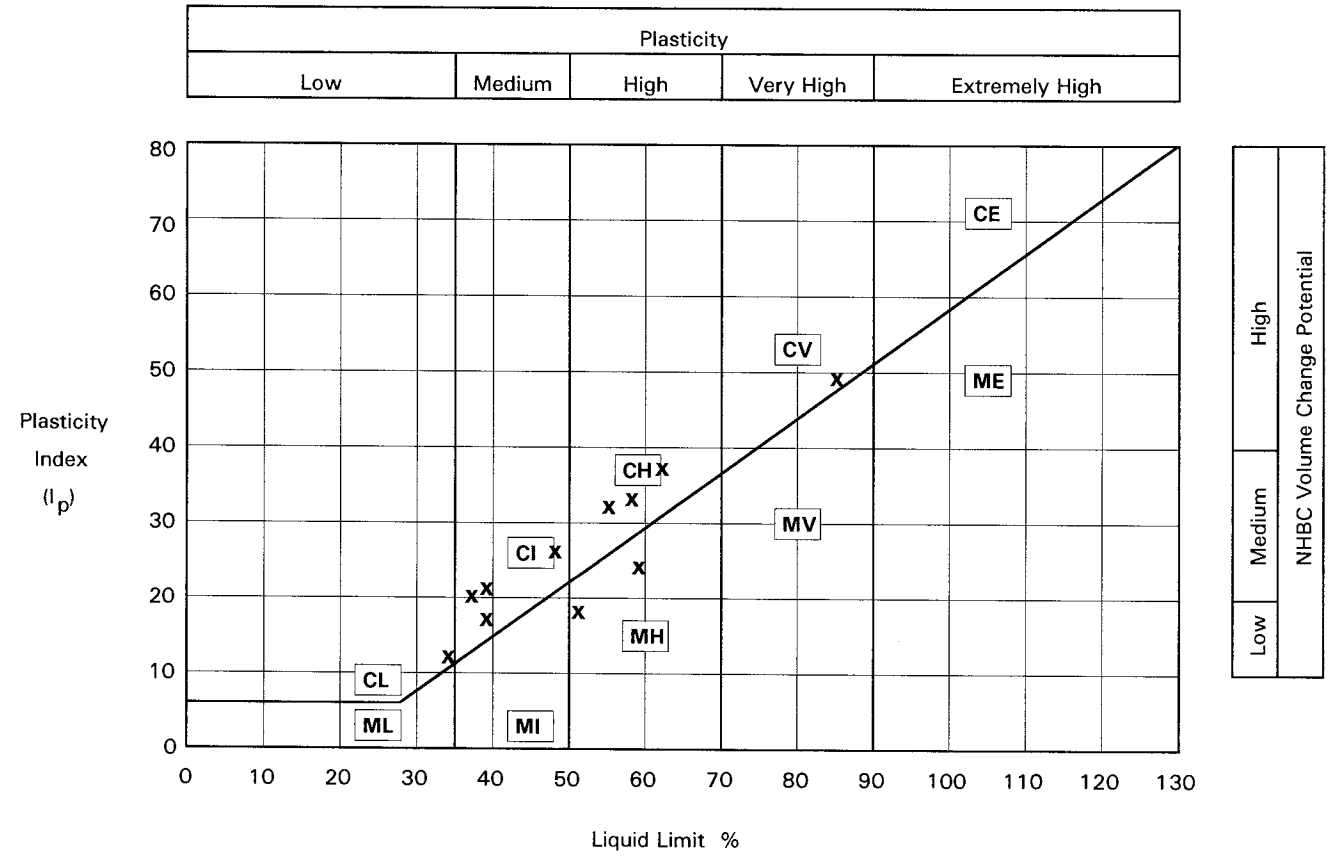
ISSUED BY : **SOIL PROPERTY TESTING LTD.**

DATE OF ISSUE : As page 1 **PAGE** 5 **of** 38

Contract Marsh Lane, Kings Lynn.

Serial No. S28408

PLOT OF PLASTICITY INDEX AGAINST LIQUID LIMIT USING CASAGRANDE CLASSIFICATION CHART



METHOD OF PREPARATION: BS 1377:PART 1:1990:7.4 & PART 2:1990:4.2

METHOD OF TEST : BS 1377:PART 2:1990:3.2, 4.4, 5.3, 5.4

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter

COMMENTS : VOLUME CHANGE POTENTIAL: NHBC Standards Chapter 4.2 Unmodified Plasticity Index PLASTICITY CHART BS5930:1999:Figure 18

TEST REPORT.

ISSUED BY : SOIL PROPERTY TESTING LTD.

DATE OF ISSUE : As page 1 **PAGE** 6 of 38

Contract Marsh Lane, Kings Lynn.

Serial No. S28408

UKAS TESTING 0998

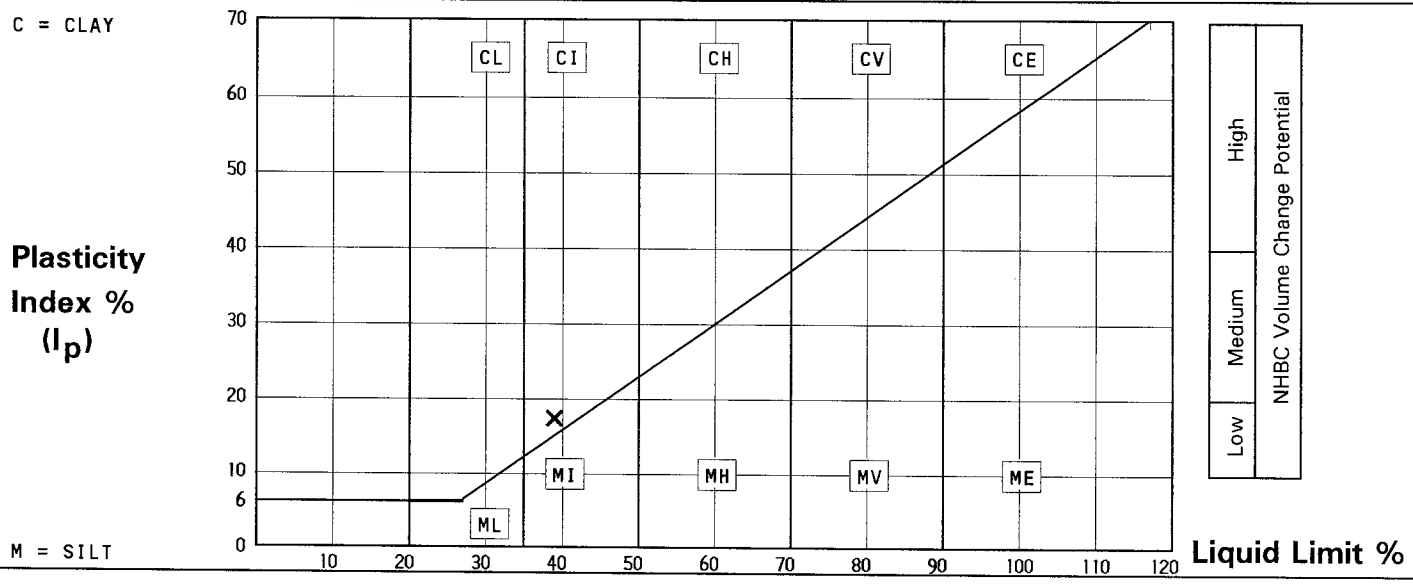
DETERMINATION OF MOISTURE CONTENT, LIQUID LIMIT AND PLASTIC LIMIT AND DERIVATION OF PLASTICITY INDEX AND LIQUIDITY INDEX

Borehole/ Pit No.	Depth m.	Sample	Moisture Content %	Description	Remarks
BH1	0.90	D3	26	Firm brown slightly sandy silty CLAY with occasional light orangey brown mottling, concrete and brick fragments and rare decayed roots	

PREPARATION

Method of Preparation	Specimen from Natural Soil		
Sample retained 0.425 sieve	(Assumed)	3	%
Corrected moisture content for material passing 0.425mm		27	%
Curing Time		24	Hours

Liquid Limit	39	%
Plastic Limit	22	%
Plasticity Index	17	%
Liquidity Index	0.29	
Clay Content	Not analysed.	%
Derived Activity (PI/CC)	Not analysed.	



METHOD OF PREPARATION: BS 1377:PART 1:1990:7.4 & PART 2:1990:4.2

METHOD OF TEST : BS 1377:PART 2:1990:3.2, 4.4 , 5.3, 5.4

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter

COMMENTS : PLASTICITY CHART BS5930:1999:Figure 18
VOLUME CHANGE POTENTIAL: NHBC Standards Chapter 4.2 Unmodified Plasticity Index
NOTE: Modified Plasticity Index I'p = Ip x (% less than 425 microns/100)
Approximately 3% gravel by dry mass picked out by hand and excluded from limits tests.
Corrected moisture content and calculated liquidity index assume material greater than 0.425mm non porous. See BS1377:Part2:1990 Clause 3 Note 1.

TEST REPORT.

ISSUED BY : SOIL PROPERTY TESTING LTD.

DATE OF ISSUE : As page 1 **PAGE** 7 of 38

Contract Marsh Lane, Kings Lynn.

Serial No. S28408

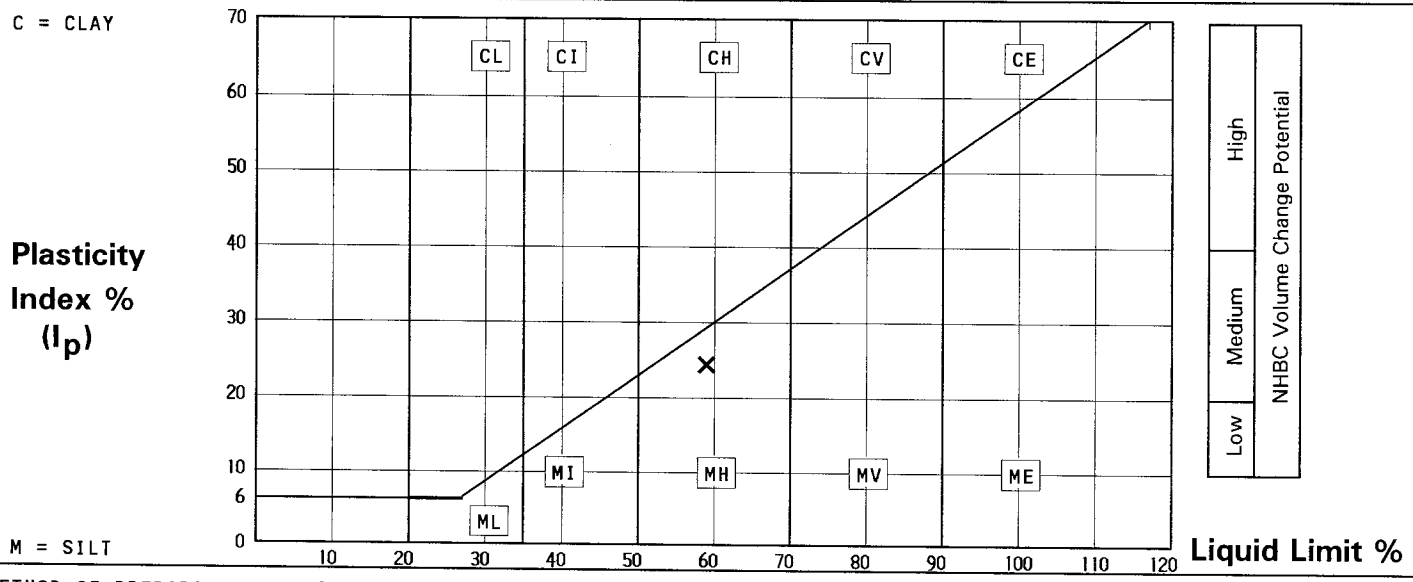
UKAS TESTING 0998

DETERMINATION OF MOISTURE CONTENT, LIQUID LIMIT AND PLASTIC LIMIT AND DERIVATION OF PLASTICITY INDEX AND LIQUIDITY INDEX

Borehole/ Pit No.	Depth m.	Sample	Moisture Content %	Description	Remarks
BH1	11.00	U6	32	Very stiff (Very high strength) fissured friable dark grey CLAY with fine and medium angular and subangular mudstone fragments and shell debris	Material noted as plotting below the A-Line

PREPARATION

Method of Preparation	Sieved Specimen	Liquid Limit	59 %
Sample retained 0.425 sieve	(Measured) 43 %	Plastic Limit	35 %
Corrected moisture content for material passing 0.425mm	%	Plasticity Index	24 %
Curing Time	24 Hours	Liquidity Index	
		Clay Content	Not analysed. %
		Derived Activity (PI/CC)	Not analysed.



METHOD OF PREPARATION: BS 1377:PART 1:1990:7.4 & PART 2:1990:4.2

METHOD OF TEST : BS 1377:PART 2:1990:3.2, 4.4 , 5.3, 5.4

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter

COMMENTS : PLASTICITY CHART BS5930:1999:Figure 18
VOLUME CHANGE POTENTIAL: NHBC Standards Chapter 4.2 Unmodified Plasticity Index
NOTE: Modified Plasticity Index I'p = Ip x (% less than 425 microns/100)
Corrected moisture content and liquidity index not reported due to material type - 34% retained on 2mm sieve.

TEST REPORT.

ISSUED BY : SOIL PROPERTY TESTING LTD.

DATE OF ISSUE : As page 1 **PAGE** 8 of 38

Contract Marsh Lane, Kings Lynn.

Serial No. S28408

UKAS TESTING 0998

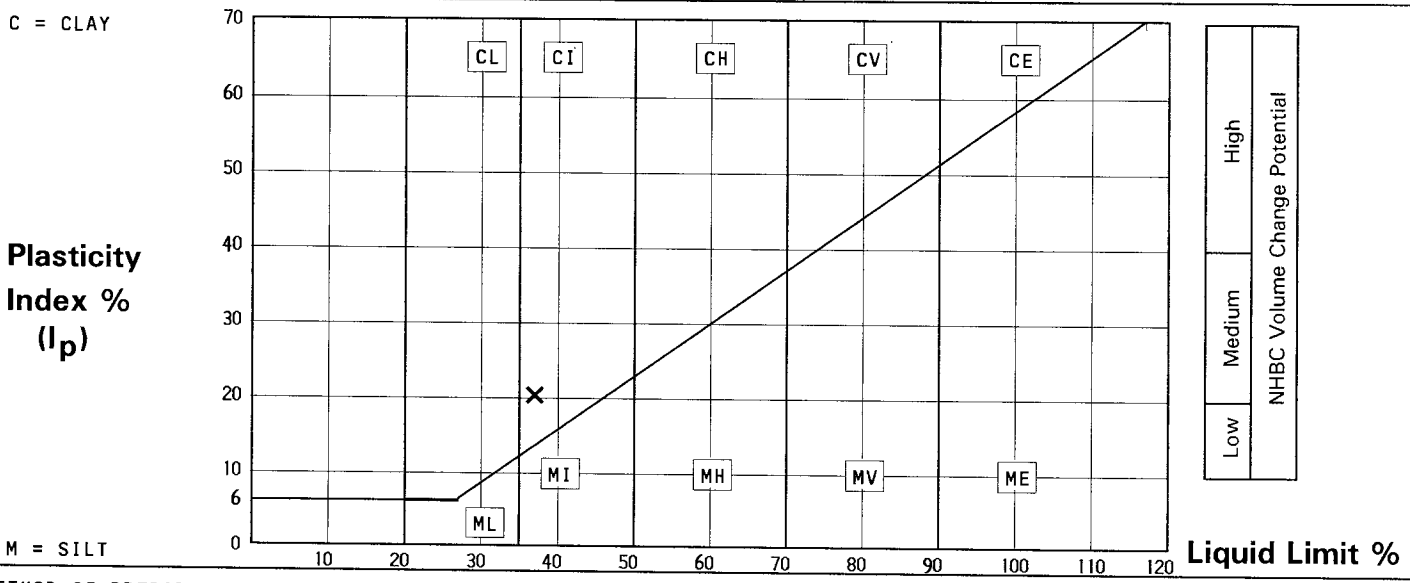
DETERMINATION OF MOISTURE CONTENT, LIQUID LIMIT AND PLASTIC LIMIT AND DERIVATION OF PLASTICITY INDEX AND LIQUIDITY INDEX

Borehole/ Pit No.	Depth m.	Sample	Moisture Content %	Description	Remarks
BH2	5.50	D8	18	Stiff fissured dark grey slightly gravelly slightly sandy silty CLAY. Gravel is fine and medium chalk	

PREPARATION

Method of Preparation	Sieved Specimen
Sample retained 0.425 sieve (Measured)	9 %
Corrected moisture content for material passing 0.425mm	20 %
Curing Time	25 Hours

Liquid Limit	37 %
Plastic Limit	17 %
Plasticity Index	20 %
Liquidity Index	0.15
Clay Content	Not analysed. %
Derived Activity (PI/CC)	Not analysed.



METHOD OF PREPARATION: BS 1377:PART 1:1990:7.4 & PART 2:1990:4.2

METHOD OF TEST : BS 1377:PART 2:1990:3.2, 4.4 , 5.3, 5.4

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter

COMMENTS : PLASTICITY CHART BS5930:1999:Figure 18
VOLUME CHANGE POTENTIAL: NHBC Standards Chapter 4.2 Unmodified Plasticity Index
NOTE: Modified Plasticity Index I'p = Ip x (% less than 425 microns/100)
7% retained on 2mm sieve.
Corrected moisture content and calculated liquidity index assume material greater than 0.425mm non porous. See BS1377:Part2:1990 Clause 3 Note 1.

TEST REPORT.

ISSUED BY : SOIL PROPERTY TESTING LTD.

DATE OF ISSUE : As page 1 **PAGE** 9 of 38

Contract Marsh Lane, Kings Lynn.

Serial No. S28408

UKAS TESTING 0998

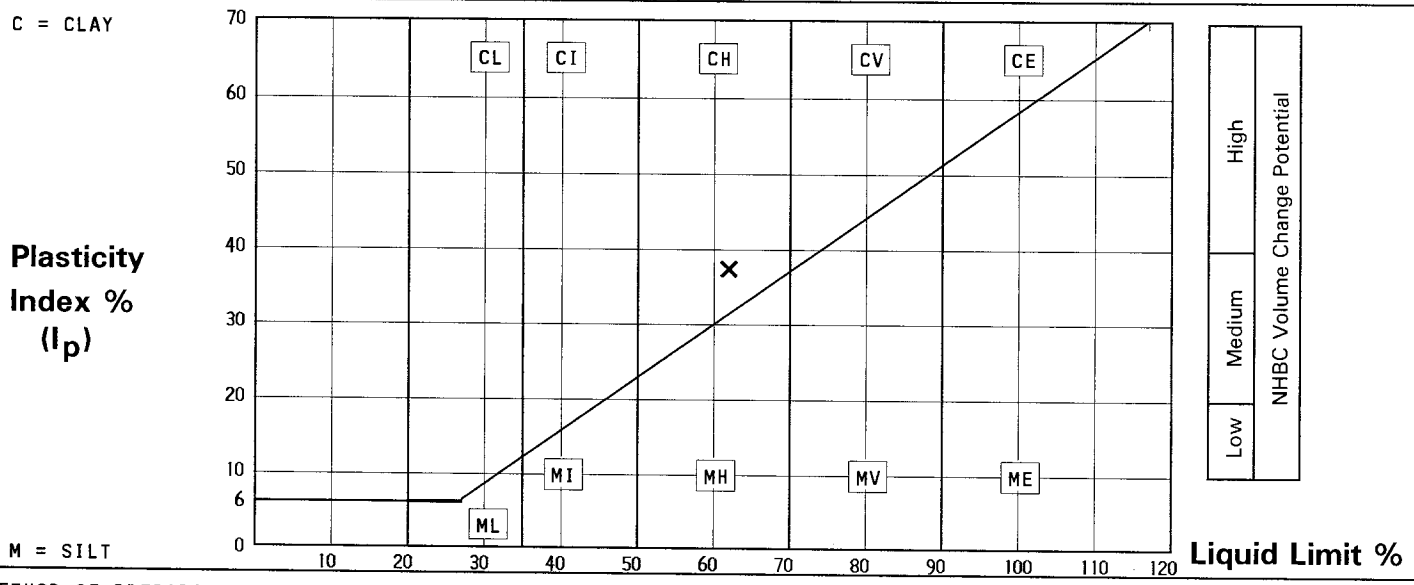
DETERMINATION OF MOISTURE CONTENT, LIQUID LIMIT AND PLASTIC LIMIT AND DERIVATION OF PLASTICITY INDEX AND LIQUIDITY INDEX

Borehole/ Pit No.	Depth m.	Sample	Moisture Content %	Description	Remarks
BH2	11.50	D16	24	Stiff fissured dark greyish brown CLAY with occasional dark olive grey	

PREPARATION

Method of Preparation	Specimen from Natural Soil
Sample retained 0.425 sieve	(Assumed) %
Corrected moisture content for material passing 0.425mm	%
Curing Time	100 Hours

Liquid Limit	62 %
Plastic Limit	25 %
Plasticity Index	37 %
Liquidity Index	-0.03
Clay Content	Not analysed. %
Derived Activity (PI/CC)	Not analysed.



METHOD OF PREPARATION: BS 1377:PART 1:1990:7.4 & PART 2:1990:4.2

METHOD OF TEST : BS 1377:PART 2:1990:3.2, 4.4 , 5.3, 5.4

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter

COMMENTS : PLASTICITY CHART BS5930:1999:Figure 18
VOLUME CHANGE POTENTIAL: NHBC Standards Chapter 4.2 Unmodified Plasticity Index
NOTE: Modified Plasticity Index I'p = Ip x (% less than 425 microns/100)

TEST REPORT.

ISSUED BY : SOIL PROPERTY TESTING LTD.

DATE OF ISSUE : As page 1 **PAGE** 10 of 38

Contract Marsh Lane, Kings Lynn.

Serial No. S28408

UKAS TESTING 0998

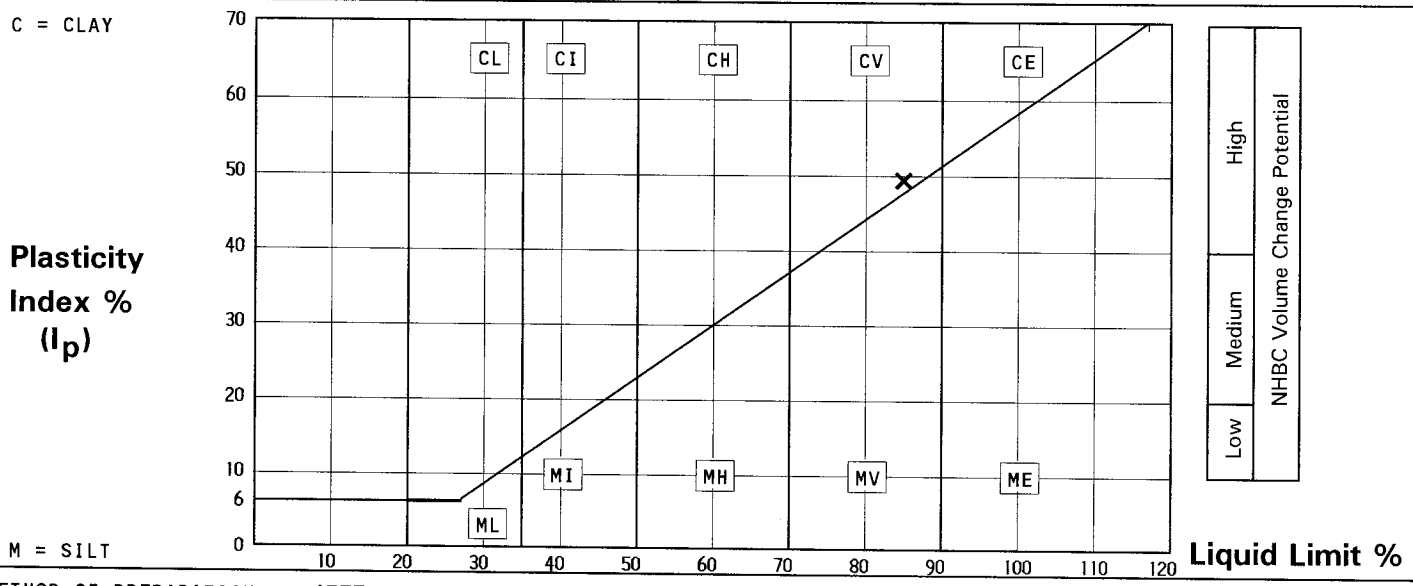
DETERMINATION OF MOISTURE CONTENT, LIQUID LIMIT AND PLASTIC LIMIT AND DERIVATION OF PLASTICITY INDEX AND LIQUIDITY INDEX

Borehole/ Pit No.	Depth m.	Sample	Moisture Content %	Description	Remarks
BH3	2.00	D4	53	Soft brown CLAY	Peat noted - probably fallen from above during sampling excluded from tests

PREPARATION

Method of Preparation	Specimen from Natural Soil
Sample retained 0.425 sieve	(Assumed) 0 %
Corrected moisture content for material passing 0.425mm	%
Curing Time	24 Hours

Liquid Limit	85 %
Plastic Limit	36 %
Plasticity Index	49 %
Liquidity Index	0.35
Clay Content	Not analysed. %
Derived Activity (PI/CC)	Not analysed.



METHOD OF PREPARATION: BS 1377:PART 1:1990:7.4 & PART 2:1990:4.2

METHOD OF TEST : BS 1377:PART 2:1990:3.2, 4.4 , 5.3, 5.4

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter

COMMENTS : PLASTICITY CHART BS5930:1999:Figure 18
VOLUME CHANGE POTENTIAL: NHBC Standards Chapter 4.2 Unmodified Plasticity Index
NOTE: Modified Plasticity Index I'p = Ip x (% less than 425 microns/100)

TEST REPORT.

ISSUED BY : **SOIL PROPERTY TESTING LTD.**

DATE OF ISSUE : As page 1 **PAGE** 11 **of** 38

Contract Marsh Lane, Kings Lynn.

Serial No. S28408

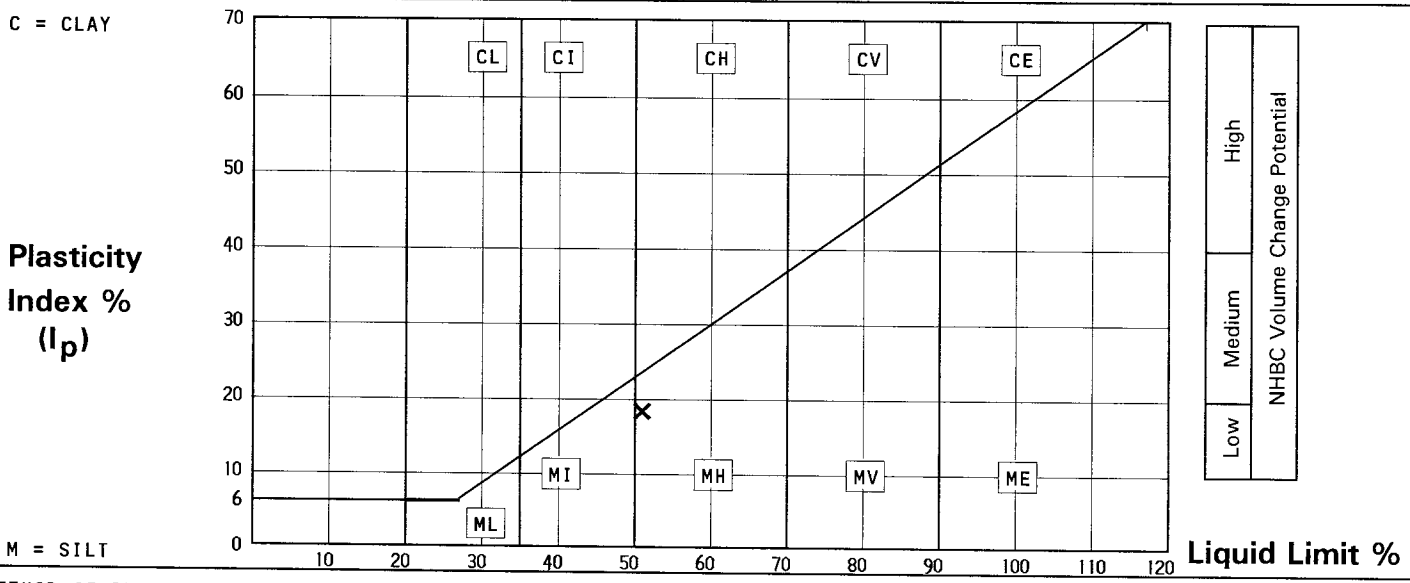
UKAS TESTING 0998

DETERMINATION OF MOISTURE CONTENT, LIQUID LIMIT AND PLASTIC LIMIT AND DERIVATION OF PLASTICITY INDEX AND LIQUIDITY INDEX

Borehole/ Pit No.	Depth m.	Sample	Moisture Content %	Description	Remarks
BH3	8.10	D13	37	Soft dark grey CLAY with claystone/mudstone fragments from fine to coarse gravel size and shell debris	Material noted as plotting below the A-Line

PREPARATION

Method of Preparation	Sieved Specimen	Liquid Limit	51 %
Sample retained 0.425 sieve	(Measured) 34 %	Plastic Limit	33 %
Corrected moisture content for material passing 0.425mm	%	Plasticity Index	18 %
Curing Time	24 Hours	Liquidity Index	
		Clay Content	Not analysed. %
		Derived Activity (PI/CC)	Not analysed.



METHOD OF PREPARATION: BS 1377:PART 1:1990:7.4 & PART 2:1990:4.2

METHOD OF TEST : BS 1377:PART 2:1990:3.2, 4.4 , 5.3, 5.4

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter

COMMENTS : PLASTICITY CHART BS5930:1999:Figure 18
VOLUME CHANGE POTENTIAL: NHBC Standards Chapter 4.2 Unmodified Plasticity Index
NOTE: Modified Plasticity Index I'p = Ip x (% less than 425 microns/100)
Corrected moisture content and liquidity index not reported due to material type - 27% retained on 2mm sieve.

TEST REPORT.

ISSUED BY : SOIL PROPERTY TESTING LTD.

DATE OF ISSUE : As page 1 **PAGE** 12 of 78

Contract Marsh Lane, Kings Lynn.

Serial No. S28408

UKAS TESTING 0998

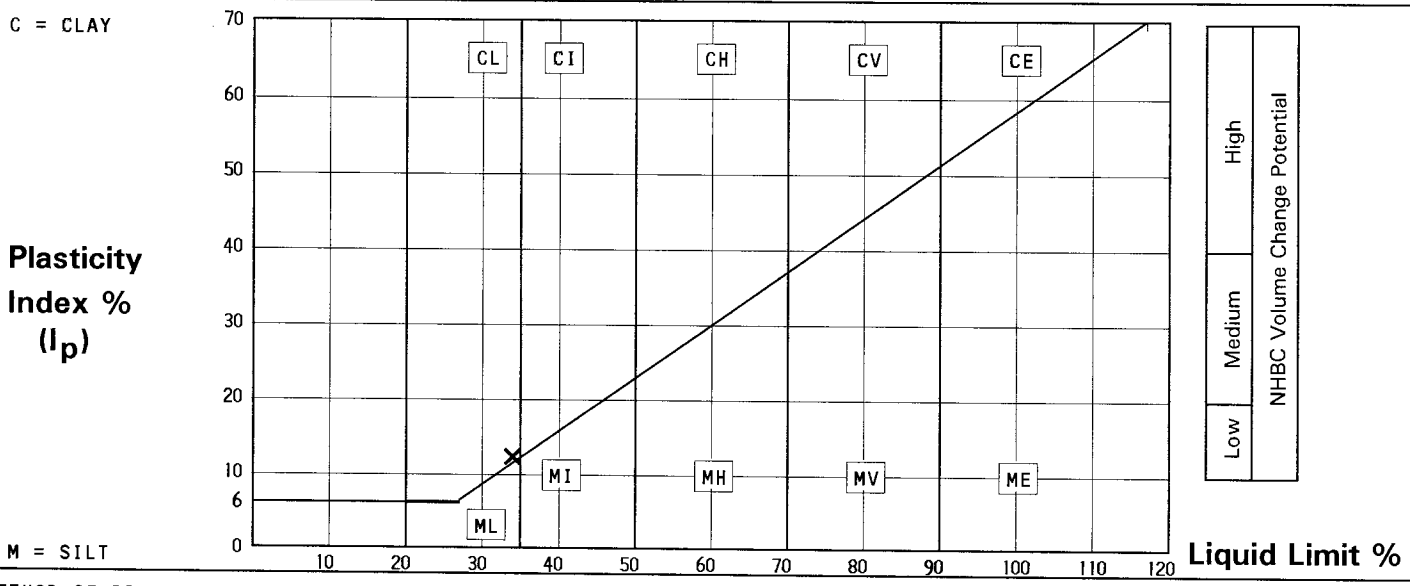
DETERMINATION OF MOISTURE CONTENT, LIQUID LIMIT AND PLASTIC LIMIT AND DERIVATION OF PLASTICITY INDEX AND LIQUIDITY INDEX

Borehole/ Pit No.	Depth m.	Sample	Moisture Content %	Description	Remarks
WS1	1.35 -1.45	D2	17	Very stiff friable yellowish brown silty CLAY with occasional recently active roots	

PREPARATION

Method of Preparation	Specimen from Natural Soil
Sample retained 0.425 sieve (Assumed)	0 %
Corrected moisture content for material passing 0.425mm	%
Curing Time	24 Hours

Liquid Limit	34 %
Plastic Limit	22 %
Plasticity Index	12 %
Liquidity Index	-0.42
Clay Content	Not analysed. %
Derived Activity (PI/CC)	Not analysed.



METHOD OF PREPARATION: BS 1377:PART 1:1990:7.4 & PART 2:1990:4.2

METHOD OF TEST : BS 1377:PART 2:1990:3.2, 4.4 , 5.3, 5.4

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter

COMMENTS : PLASTICITY CHART BS5930:1999:Figure 18
VOLUME CHANGE POTENTIAL: NHBC Standards Chapter 4.2 Unmodified Plasticity Index
NOTE: Modified Plasticity Index I'p = Ip x (% less than 425 microns/100)

TEST REPORT.

ISSUED BY : SOIL PROPERTY TESTING LTD.

DATE OF ISSUE : As page 1 **PAGE** 13 of 38

Contract Marsh Lane, Kings Lynn.

Serial No. S28408

UKAS TESTING 0998

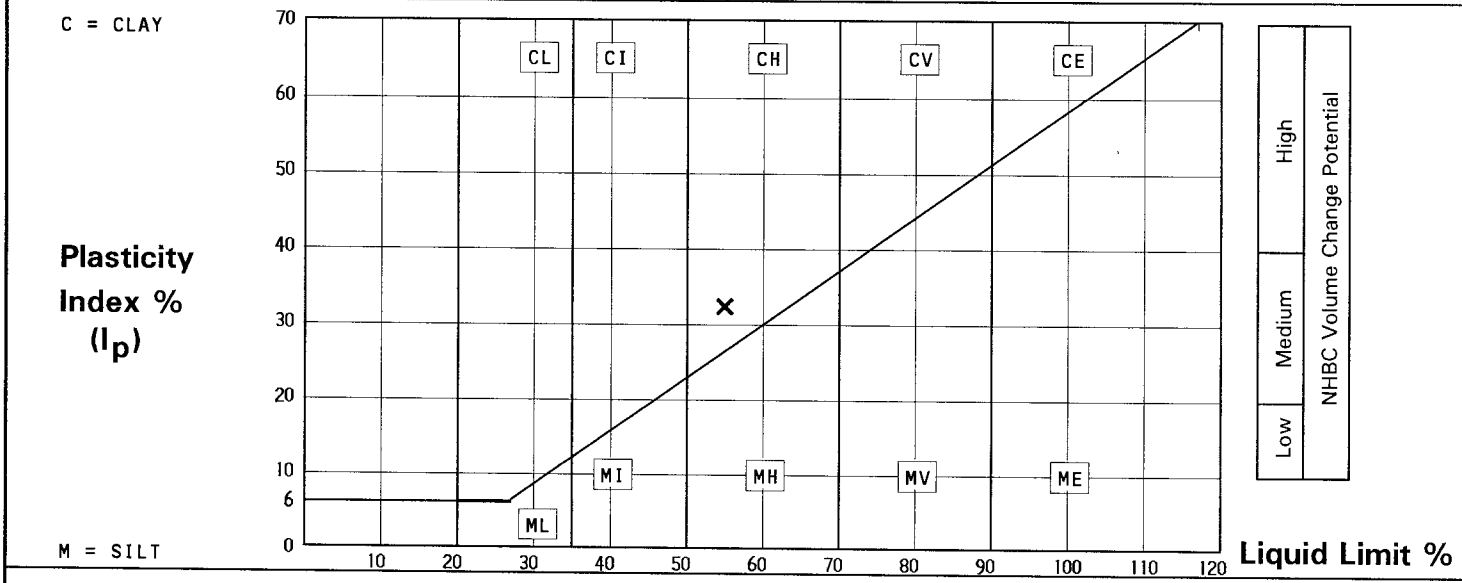
DETERMINATION OF MOISTURE CONTENT, LIQUID LIMIT AND PLASTIC LIMIT AND DERIVATION OF PLASTICITY INDEX AND LIQUIDITY INDEX

Borehole/ Pit No.	Depth m.	Sample	Moisture Content %	Description	Remarks
WS6	0.90 -1.00	D2	27	Stiff dark yellowish brown CLAY with occasional bluish grey veins and decayed roots	

PREPARATION

Method of Preparation	Specimen from Natural Soil
Sample retained 0.425 sieve	(Assumed) 0 %
Corrected moisture content for material passing 0.425mm	%
Curing Time	24 Hours

Liquid Limit	55 %
Plastic Limit	23 %
Plasticity Index	32 %
Liquidity Index	0.13
Clay Content	Not analysed. %
Derived Activity (PI/CC)	Not analysed.



METHOD OF PREPARATION: BS 1377:PART 1:1990:7.4 & PART 2:1990:4.2

METHOD OF TEST : BS 1377:PART 2:1990:3.2, 4.4 , 5.3, 5.4

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter

COMMENTS : PLASTICITY CHART BS5930:1999:Figure 18
VOLUME CHANGE POTENTIAL: NHBC Standards Chapter 4.2 Unmodified Plasticity Index
NOTE: Modified Plasticity Index I'p = Ip x (% less than 425 microns/100)

TEST REPORT.

ISSUED BY : SOIL PROPERTY TESTING LTD.

DATE OF ISSUE : As page 1 **PAGE** 14 of 38

Contract Marsh Lane, Kings Lynn.

Serial No. S28408

UKAS TESTING 0998

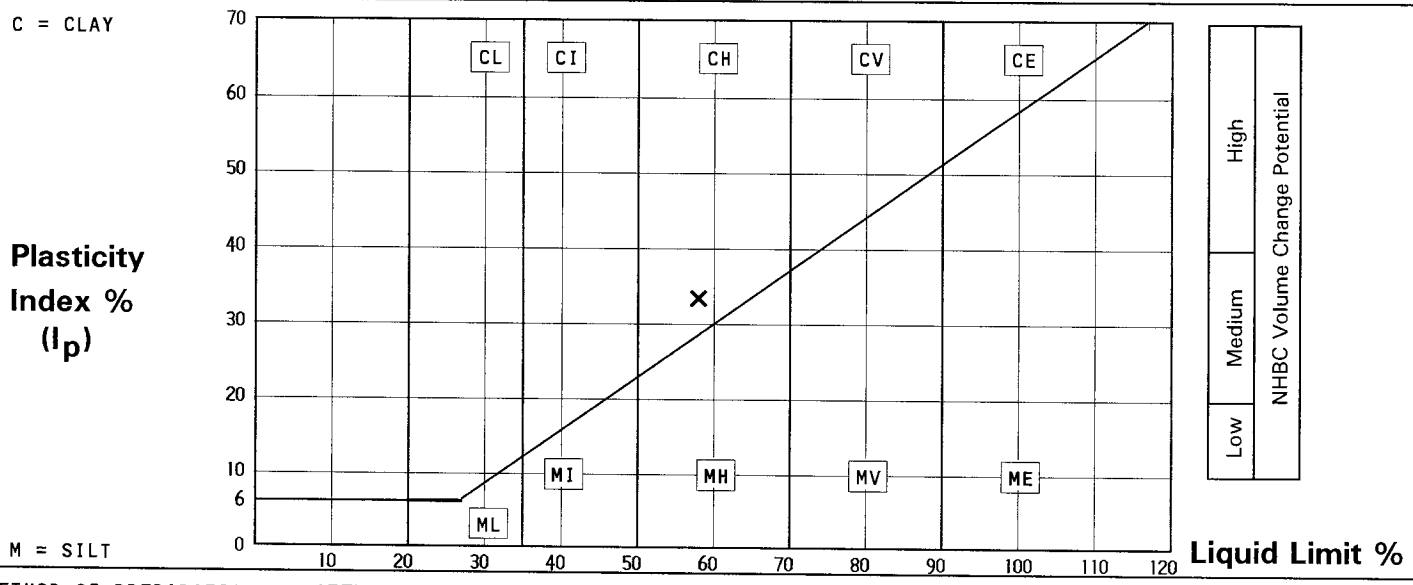
DETERMINATION OF MOISTURE CONTENT, LIQUID LIMIT AND PLASTIC LIMIT AND DERIVATION OF PLASTICITY INDEX AND LIQUIDITY INDEX

Borehole/ Pit No.	Depth m.	Sample	Moisture Content %	Description	Remarks
WS7	1.00 -1.45	D2	33	Stiff dark yellowish brown CLAY with occasional recently active roots	

PREPARATION

Method of Preparation	Specimen from Natural Soil
Sample retained 0.425 sieve (Assumed)	0 %
Corrected moisture content for material passing 0.425mm	%
Curing Time	24 Hours

Liquid Limit	58 %
Plastic Limit	25 %
Plasticity Index	33 %
Liquidity Index	0.24
Clay Content	Not analysed. %
Derived Activity (PI/CC)	Not analysed.



METHOD OF PREPARATION: BS 1377:PART 1:1990:7.4 & PART 2:1990:4.2

METHOD OF TEST : BS 1377:PART 2:1990:3.2, 4.4 , 5.3, 5.4

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter

COMMENTS : PLASTICITY CHART BS5930:1999:Figure 18
VOLUME CHANGE POTENTIAL: NHBC Standards Chapter 4.2 Unmodified Plasticity Index
NOTE: Modified Plasticity Index I'p = Ip x (% less than 425 microns/100)

TEST REPORT.

ISSUED BY : SOIL PROPERTY TESTING LTD.

DATE OF ISSUE : As page 1 **PAGE** 15 of 38

Contract Marsh Lane, Kings Lynn.

Serial No. S28408

UKAS TESTING 0998

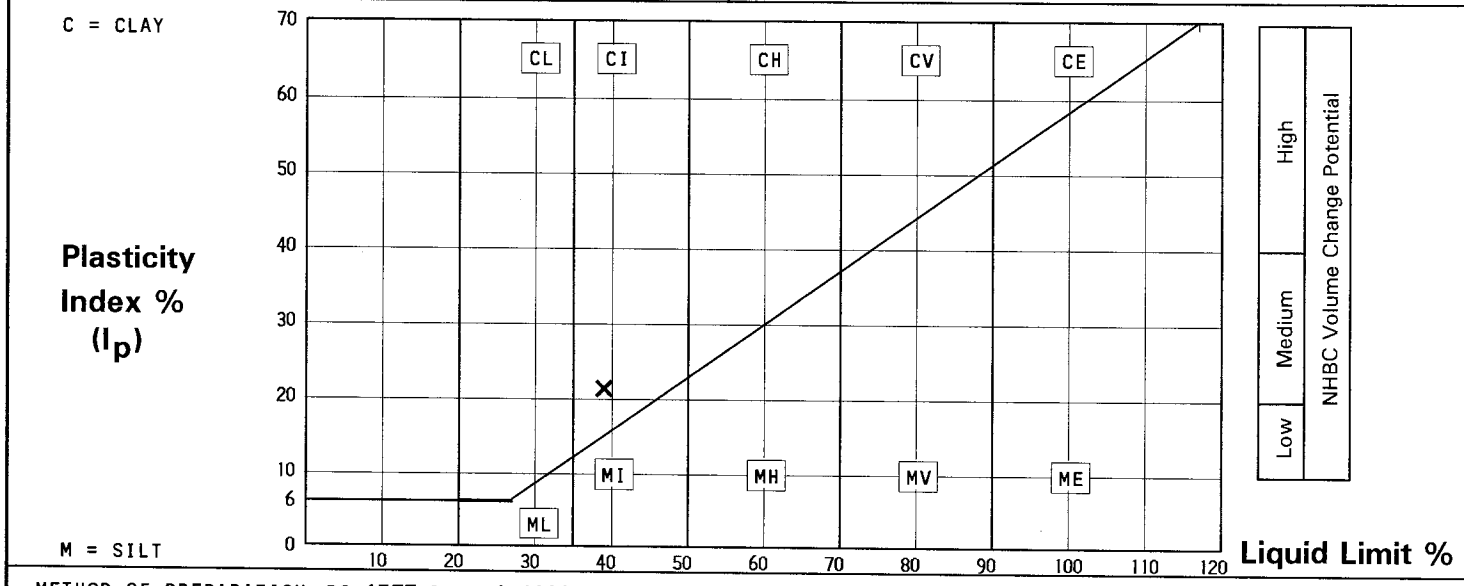
DETERMINATION OF MOISTURE CONTENT, LIQUID LIMIT AND PLASTIC LIMIT AND DERIVATION OF PLASTICITY INDEX AND LIQUIDITY INDEX

Borehole/ Pit No.	Depth m.	Sample	Moisture Content %	Description	Remarks
WS9	3.50	B4	22	Firm grey and light olive brown slightly gravelly slightly sandy silty CLAY with occasional dark grey and yellowish brown mottling and rare decayed roots. Gravel is fine and medium rounded to subangular chalk	

PREPARATION

Method of Preparation	Sieved Specimen
Sample retained 0.425 sieve (Measured)	7 %
Corrected moisture content for material passing 0.425mm	24 %
Curing Time	24 Hours

Liquid Limit	39 %
Plastic Limit	18 %
Plasticity Index	21 %
Liquidity Index	0.29
Clay Content	Not analysed. %
Derived Activity (PI/CC)	Not analysed.



METHOD OF PREPARATION: BS 1377:PART 1:1990:7.4 & PART 2:1990:4.2

METHOD OF TEST : BS 1377:PART 2:1990:3.2, 4.4, 5.3, 5.4

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter

COMMENTS : PLASTICITY CHART BS5930:1999:Figure 18
VOLUME CHANGE POTENTIAL: NHBC Standards Chapter 4.2 Unmodified Plasticity Index
NOTE: Modified Plasticity Index I'p = Ip x (% less than 425 microns/100)
4% retained on 2mm sieve.
Corrected moisture content and calculated liquidity index assume material greater than 0.425mm non porous. See BS1377:Part2:1990 Clause 3 Note 1.

TEST REPORT.

ISSUED BY : SOIL PROPERTY TESTING LTD.

DATE OF ISSUE : As page 1 **PAGE** 16 of 38

Contract Marsh Lane, Kings Lynn.

Serial No. S28408

UKAS TESTING 0998

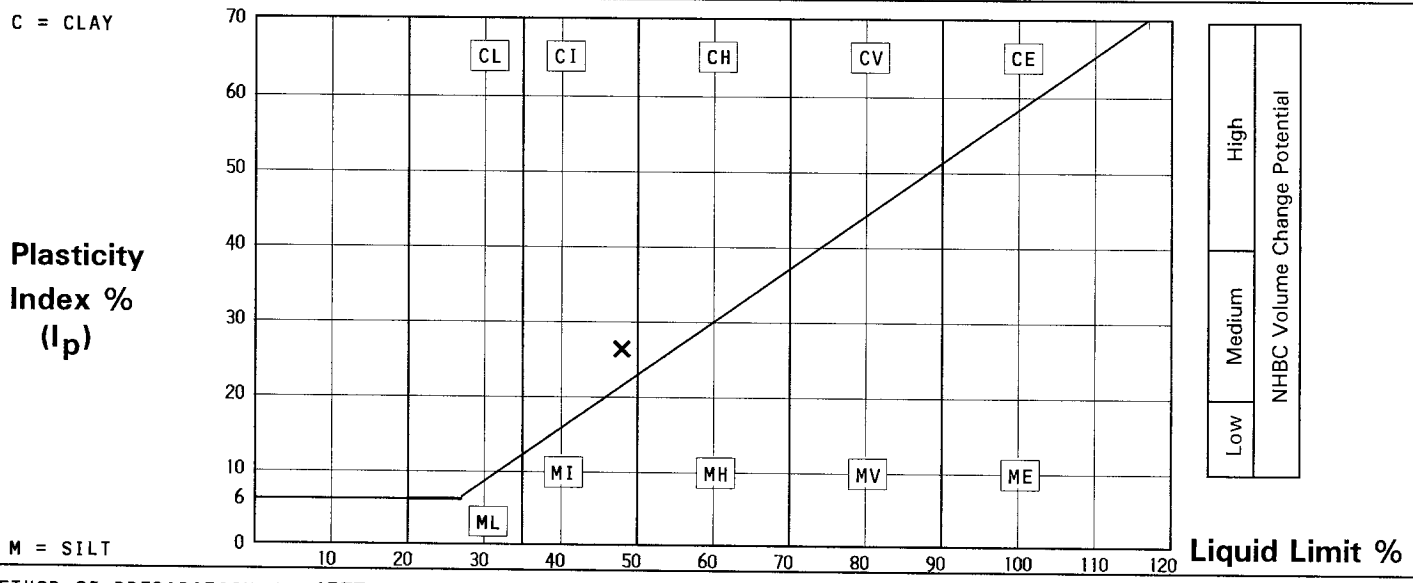
DETERMINATION OF MOISTURE CONTENT, LIQUID LIMIT AND PLASTIC LIMIT AND DERIVATION OF PLASTICITY INDEX AND LIQUIDITY INDEX

Borehole/ Pit No.	Depth m.	Sample	Moisture Content %	Description	Remarks
WS12	3.65	B3	25	Firm dark grey and olive grey slightly gravelly slightly sandy silty CLAY with occasional olive mottling and rare decayed roots. Gravel is fine and medium subrounded and subangular chalk	

PREPARATION

Method of Preparation	Sieved Specimen
Sample retained 0.425 sieve (Measured)	8 %
Corrected moisture content for material passing 0.425mm	27 %
Curing Time	25 Hours

Liquid Limit	48 %
Plastic Limit	22 %
Plasticity Index	26 %
Liquidity Index	0.19
Clay Content	Not analysed. %
Derived Activity (PI/CC)	Not analysed.



METHOD OF PREPARATION: BS 1377:PART 1:1990:7.4 & PART 2:1990:4.2

METHOD OF TEST : BS 1377:PART 2:1990:3.2, 4.4 , 5.3, 5.4

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter

COMMENTS : PLASTICITY CHART BS5930:1999:Figure 18
VOLUME CHANGE POTENTIAL: NHBC Standards Chapter 4.2 Unmodified Plasticity Index
NOTE: Modified Plasticity Index I'p = Ip x (% less than 425 microns/100)
4% retained on 2mm sieve.
Corrected moisture content and calculated liquidity index assume material greater than 0.425mm non porous. See BS1377:Part2:1990 Clause 3 Note 1.

TEST REPORT.

ISSUED BY : **SOIL PROPERTY TESTING LTD.**

DATE OF ISSUE : As page 1 **PAGE** 17 **of** 38

Contract Marsh Lane, Kings Lynn.

Serial No. S28408

UKAS TESTING 0998

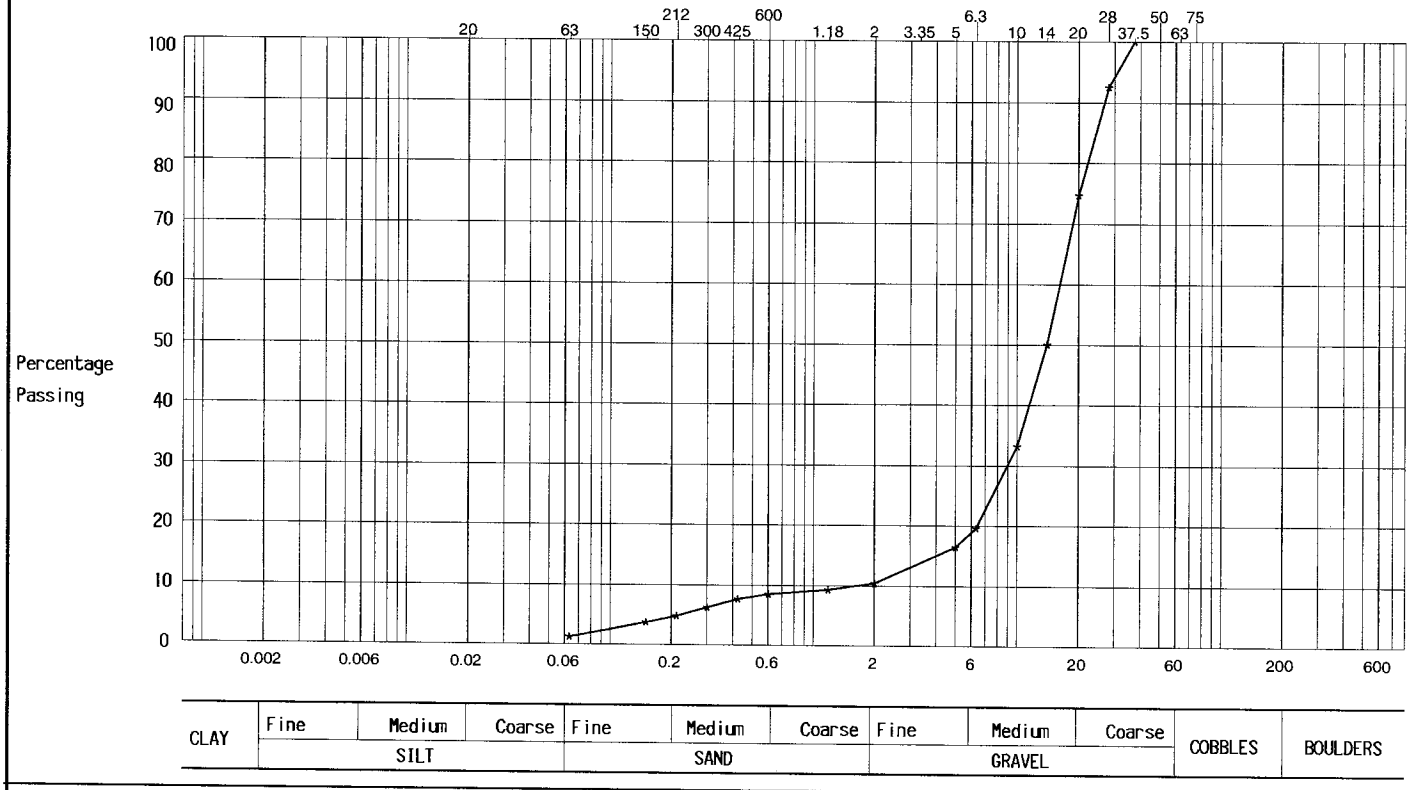
DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole/ Pit No.	Depth m.	Sample	Description	Remarks
BH2	1.20 -1.70	B2	Black, white and brown slightly silty sandy subangular and subrounded GRAVEL. Sand is brown	

Method of Test: Wet Sieve

Method of pre-treatment:

Size (microns)												Size (mm)										
Sieve Size	63	150	212	300	425	600	1.18	2	5	6.3	10	14	20	28	37.5	50	75					
Percentage by Mass passing Sieve	1	4	5	6	8	8	9	10	16	20	33	50	75	92	100	-	-					



METHOD OF PREPARATION: BS 1377:PART 1:1990:7.3 & 7.4.5

METHOD OF TEST : BS 1377:PART 2:1990:9.2

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter

COMMENTS :

REMARKS TO INCLUDE : Sample disturbance, loss of moisture, variation from test procedure, location and origin of test specimen within original sample. Oven drying temperature if not 105-110 deg C.

TEST REPORT.

ISSUED BY : SOIL PROPERTY TESTING LTD.

DATE OF ISSUE : As page 1 **PAGE** 18 of 38

Contract Marsh Lane, Kings Lynn.

Serial No. S28408

UKAS TESTING 0998

DETERMINATION OF DENSITY, MOISTURE CONTENT AND UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION WITHOUT MEASUREMENT OF PORE PRESSURE

Borehole/ Pit No.	Depth m.	Sample	Moisture Content (%)	Bulk Density (Mg/m^3)	Dry Density (Mg/m^3)	Lateral Pressure (kPa)	Deviator Stress (kPa)	Shear Stress (kPa)	MOHRS CIRCLE ANALYSIS Cu (kPa)	MOHRS CIRCLE ANALYSIS ∅ (degrees)	Description
BH1	1.20	U1	26	2.02	1.60	26	103	52			Firm (Medium strength) yellowish brown sandy silty CLAY with occasional recently active roots
BH1	2.00	U2	28	1.93	1.51	40	139	70			Yellowish brown and light olive brown very silty fine SAND with rare decayed roots
BH1	4.00	U3	341	1.09	0.25	80	117	58			Firm (Medium strength) black and dark brown fibrous PEAT
BH1	8.00	U5	16	2.16	1.86	159	246	123			Stiff (High strength) dark grey slightly gravelly slightly sandy silty CLAY. Gravel is fine and medium chalk and flint
BH1	11.00	U6	32	1.59	1.20	218	337	169			Very stiff (Very high strength) fissured friable dark grey CLAY with fine and medium angular and subangular mudstone fragments and shell debris
BH1	14.20	U7	27	1.95	1.54	285	238	119			Stiff (High strength) very dark grey CLAY with rare shell debris
BH2	3.00	U1	18	2.15	1.82	60	225	112			Stiff (High strength) dark grey slightly gravelly slightly sandy silty CLAY. Gravel is fine and medium chalk and rare flint
BH2	5.00	U2	18	2.15	1.82	99	403	201			Very stiff (Very high strength) dark grey slightly gravelly slightly sandy silty CLAY. Gravel is fine and medium chalk and rare flint
BH2	8.00	U3	16	2.13	1.84	160	501	251			Very stiff (Very high strength) dark grey slightly gravelly slightly sandy silty CLAY. Gravel is fine to coarse chalk and rare flint
BH2	11.00	U4	24	2.04	1.65	219	264	132			Stiff (High strength) fissured dark grey CLAY

METHOD OF PREPARATION : BS 1377:PART 1:1990:7.4.2 & 8 PART 2:1990:7.2 PART 7:1990:8.3

METHOD OF TEST : BS 1377:PART 2:1990:3 Determination of Moisture Content 1990:7 Determination of Density
:PART 7:1990:8 Undrained Shear Strength 1990:9 Multi-stage test
Note Multi-stage test used when specimen has granular content / behaviour and length of specimen precludes the taking of 3 x 100mm dia by 200mm long specimens.

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter

COMMENTS :

REMARKS TO INCLUDE : Sample disturbance, loss of moisture, variation from test procedure, location and origin of test specimen within original sample. Oven drying temperature if not 105-110 deg C.

TEST REPORT.

ISSUED BY : SOIL PROPERTY TESTING LTD.

DATE OF ISSUE : As page 1 **PAGE** 19 of 38

Contract Marsh Lane, Kings Lynn.

Serial No. S28408

UKAS TESTING 0998

DETERMINATION OF DENSITY, MOISTURE CONTENT AND UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION WITHOUT MEASUREMENT OF PORE PRESSURE

Borehole/ Pit No.	Depth m.	Sample	Moisture Content (%)	Bulk Density (Mg/m^3)	Dry Density (Mg/m^3)	Lateral Pressure (kPa)	Deviator Stress (kPa)	Shear Stress (kPa)	MOHRS CIRCLE ANALYSIS Cu (kPa)	MOHRS CIRCLE ANALYSIS ∅ (degrees)	Description
BH2	13.50	U5	26	1.98	1.57	269	269	134			Stiff (High strength) fissured dark grey CLAY with occasional shell debris
BH3	3.60	U3	19	2.07	1.74	76	253	127			Stiff (High strength) dark grey slightly gravelly slightly sandy silty CLAY with occasional olive mottling and rare selenite crystals. Gravel is fine and medium chalk
BH3	5.60	U4	26	2.06	1.63	113	206	103			Stiff (High strength) fissured dark grey CLAY with rare selenite crystals
BH3	10.80	U5	28	1.94	1.52	215	232	116			Stiff (High strength) fissured dark grey CLAY with frequent shell debris
BH3	13.80	U6	27	1.97	1.55	278	288	144			Stiff (High strength) fissured dark grey CLAY

METHOD OF PREPARATION : BS 1377:PART 1:1990:7.4.2 & 8 PART 2:1990:7.2 PART 7:1990:8.3

METHOD OF TEST : BS 1377:PART 2:1990:3 Determination of Moisture Content 1990:7 Determination of Density
:PART 7:1990:8 Undrained Shear Strength 1990:9 Multi-stage test
Note Multi-stage test used when specimen has granular content / behaviour and length of specimen precludes the taking of 3 x 100mm dia by 200mm long specimens.

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter

COMMENTS :

REMARKS TO INCLUDE : Sample disturbance, loss of moisture, variation from test procedure, location and origin of test specimen within original sample. Oven drying temperature if not 105-110 deg C.

TEST REPORT.

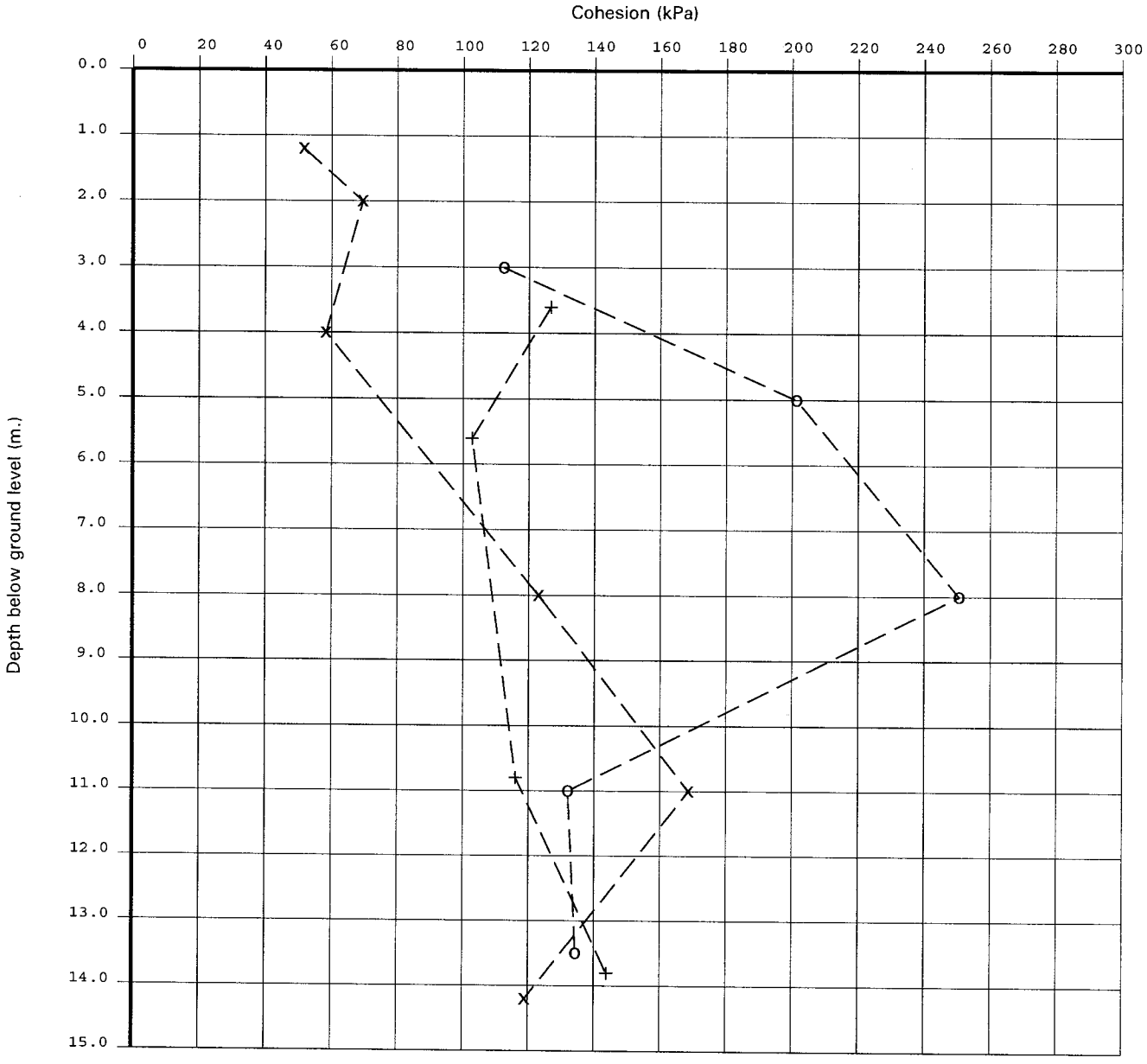
ISSUED BY : SOIL PROPERTY TESTING LTD.

DATE OF ISSUE : As page 1 **PAGE** 20 of 38

Contract Marsh Lane, Kings Lynn.

Serial No. S28408

Cohesion (kPa) vs Depth below ground level (m.).



Key to Data Points	x : BH1	o : BH2	+ : BH3					

SPTPLOT

TEST REPORT.

ISSUED BY : **SOIL PROPERTY TESTING LTD.**

DATE OF ISSUE : As page 1 **PAGE** 21 **of** 38

Contract Marsh Lane, Kings Lynn.

Serial No. S28408

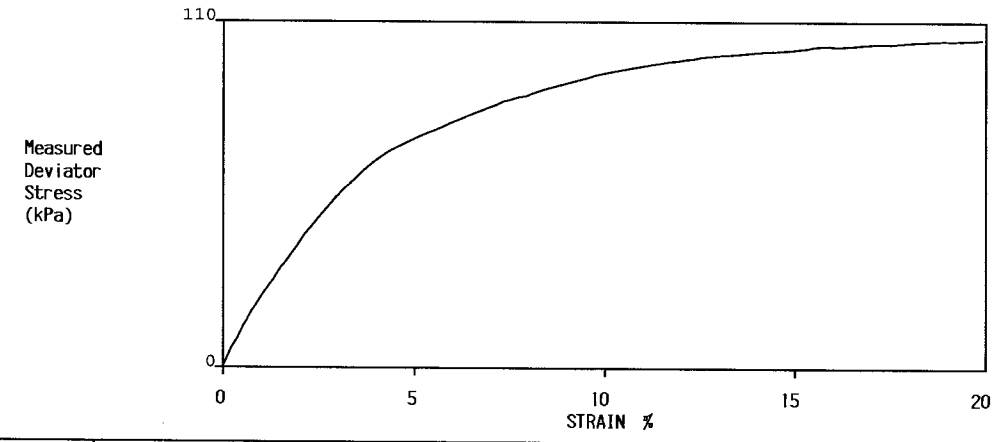
UKAS TESTING 0998

DETERMINATION OF UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION WITHOUT MEASUREMENT OF PORE PRESSURE

Borehole/ Pit No.	Depth m.	Sample	Description	Remarks
BH1	1.20	U1	Firm (Medium strength) yellowish brown sandy silty CLAY with occasional recently active roots	

Initial Specimen	Height mm	Diameter mm	Weight g	Moisture Content %	Wet Density Mg/m^3	Dry Density Mg/m^3
Depth of Top of Specimen (m) 1.22	170.0	101.7	2795	26	2.02	1.60

TEST INFORMATION — Rate of Strain 1.7 % per Min — Rubber Membrane Thickness 0.3 mm



Specimen at Failure	Measured Cell Pressure $\sigma 3$ (kPa)	Strain at Failure (%)	Stress Corrections (kPa)		Corrected Max. Deviator Stress $\sigma 1 - \sigma 3$ (kPa)	Shear Stress Cu $\frac{1}{2}(\sigma 1 - \sigma 3)_f$ (kPa)	Mohrs Circle Analysis	
			Rubber Membrane	Piston Friction			Cu (kPa)	PHI °
	26	20.1	1.1	/	103	52		

METHOD OF PREPARATION: BS 1377:PART 1:1990:

METHOD OF TEST : BS 1377:PART 7:1990:8 Definitive Method. 1990:9 Multi-stage loading

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter

COMMENTS : Tested in Vertical Orientation.
UKAS Calibration - loads from 0.2 to 10kN.

REMARKS TO INCLUDE : Sample disturbance, loss of moisture, variation from test procedure, location and origin of test specimen within original sample. Oven drying temperature if not 105-110 deg C.

TEST REPORT.

ISSUED BY : SOIL PROPERTY TESTING LTD.

DATE OF ISSUE : As page 1 **PAGE** 11 of 38

Contract Marsh Lane, Kings Lynn.

Serial No. S28408

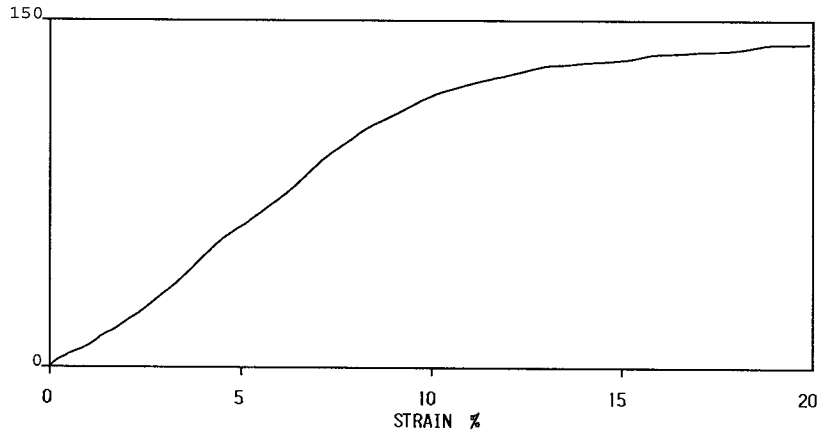
UKAS TESTING 0998

DETERMINATION OF UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION WITHOUT MEASUREMENT OF PORE PRESSURE

Borehole/ Pit No.	Depth m.	Sample	Description	Remarks
BH1	2.00	U2	Yellowish brown and light olive brown very silty fine SAND with rare decayed roots	

Initial Specimen	Height mm	Diameter mm	Weight g	Moisture Content %	Wet Density Mg/m^3	Dry Density Mg/m^3
Depth of Top of Specimen (m) 2.06	169.4	103.6	2751	28	1.93	1.51

TEST INFORMATION — Rate of Strain 1.7 % per Min — Rubber Membrane Thickness 0.3 mm



Specimen at Failure	Measured Cell Pressure σ_3 (kPa)	Strain at Failure (%)	Stress Corrections (kPa)		Corrected Max. Deviator Stress $\sigma_1 - \sigma_3$ (kPa)	Shear Stress Cu $\frac{1}{2}(\sigma_1 - \sigma_3)_f$ (kPa)	Mohrs Circle Analysis	
			Rubber Membrane	Piston Friction			Cu (kPa)	PHI °
	40	20.1	1.1	/	139	70		

METHOD OF PREPARATION: BS 1377:PART 1:1990:

METHOD OF TEST : BS 1377:PART 7:1990:8 Definitive Method. 1990:9 Multi-stage loading

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter

COMMENTS : Tested in Vertical Orientation.
UKAS Calibration - loads from 0.2 to 10kN.

REMARKS TO INCLUDE : Sample disturbance, loss of moisture, variation from test procedure, location and origin of test specimen within original sample. Oven drying temperature if not 105-110 deg C.

TEST REPORT.

ISSUED BY : SOIL PROPERTY TESTING LTD.

DATE OF ISSUE : As page 1 **PAGE** 23 of 38

Contract Marsh Lane, Kings Lynn.

Serial No. S28408

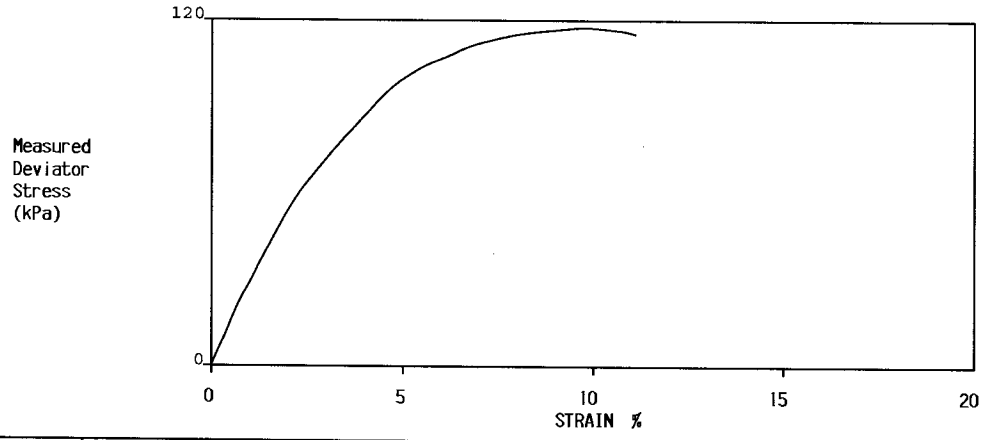
UKAS TESTING 0998

DETERMINATION OF UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION WITHOUT MEASUREMENT OF PORE PRESSURE

Borehole/ Pit No.	Depth m.	Sample	Description	Remarks
BH1	4.00	U3	Firm (Medium strength) black and dark brown fibrous PEAT	

Initial Specimen	Height mm	Diameter mm	Weight g	Moisture Content %	Wet Density Mg/m^3	Dry Density Mg/m^3
Depth of Top of Specimen (m) 4.06	194.7	101.6	1715	341	1.09	0.25

TEST INFORMATION — Rate of Strain 1.5 % per Min — Rubber Membrane Thickness 0.3 mm



Specimen at Failure	Measured Cell Pressure $\sigma 3$ (kPa)	Strain at Failure (%)	Stress Corrections (kPa)		Corrected Max. Deviator Stress $\sigma 1 - \sigma 3$ (kPa)	Shear Stress Cu $\frac{1}{2}(\sigma 1 - \sigma 3)_f$ (kPa)	Mohrs Circle Analysis	
			Rubber Membrane	Piston Friction			Cu (kPa)	PHI °
	80	9.7	0.7	/	117	58		

METHOD OF PREPARATION: BS 1377:PART 1:1990:

METHOD OF TEST : BS 1377:PART 7:1990:8 Definitive Method. 1990:9 Multi-stage loading

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter

COMMENTS : Tested in Vertical Orientation.
UKAS Calibration - loads from 0.2 to 10kN.

REMARKS TO INCLUDE : Sample disturbance, loss of moisture, variation from test procedure, location and origin of test specimen within original sample. Oven drying temperature if not 105-110 deg C.

TEST REPORT.

ISSUED BY : SOIL PROPERTY TESTING LTD.

DATE OF ISSUE : As page 1 **PAGE** 14 of 38

Contract Marsh Lane, Kings Lynn.

Serial No. S28408

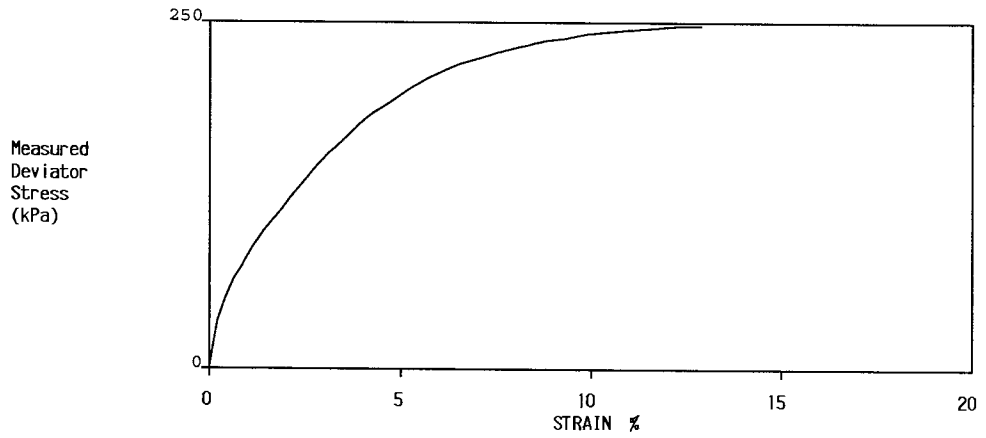
UKAS TESTING 0998

DETERMINATION OF UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION WITHOUT MEASUREMENT OF PORE PRESSURE

Borehole/ Pit No.	Depth m.	Sample	Description	Remarks
BH1	8.00	U5	Stiff (High strength) dark grey slightly gravelly slightly sandy silty CLAY. Gravel is fine and medium chalk and flint	

Initial Specimen	Height mm	Diameter mm	Weight g	Moisture Content %	Wet Density Mg/m^3	Dry Density Mg/m^3
Depth of Top of Specimen (m) 8.04	199.6	102.4	3548	16	2.16	1.86

TEST INFORMATION — Rate of Strain 1.5 % per Min — Rubber Membrane Thickness 0.6 mm



Specimen at Failure	Measured Cell Pressure $\sigma 3$ (kPa)	Strain at Failure (%)	Stress Corrections (kPa)		Corrected Max. Deviator Stress $\sigma 1 - \sigma 3$ (kPa)	Shear Stress Cu $\frac{1}{2}(\sigma 1 - \sigma 3)_f$ (kPa)	Mohrs Circle Analysis	
			Rubber Membrane	Piston Friction			Cu (kPa)	PHI °
	159	12.1	1.4	/	246	123		

METHOD OF PREPARATION: BS 1377:PART 1:1990:

METHOD OF TEST : BS 1377:PART 7:1990:8 Definitive Method. 1990:9 Multi-stage loading

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter

COMMENTS : Tested in Vertical Orientation.
UKAS Calibration - loads from 0.2 to 10kN.

REMARKS TO INCLUDE : Sample disturbance, loss of moisture, variation from test procedure, location and origin of test specimen within original sample. Oven drying temperature if not 105-110 deg C.

TEST REPORT.

ISSUED BY : SOIL PROPERTY TESTING LTD.

DATE OF ISSUE : As page 1 **PAGE** 25 of 38

Contract Marsh Lane, Kings Lynn.

Serial No. S28408

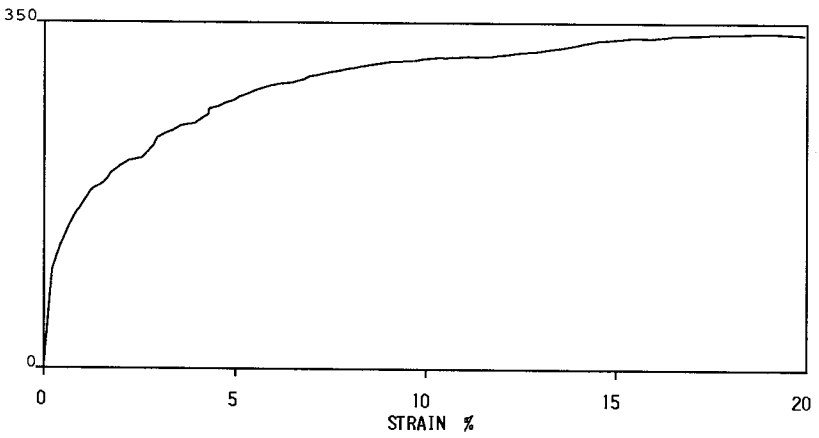
UKAS TESTING 0998

DETERMINATION OF UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION WITHOUT MEASUREMENT OF PORE PRESSURE

Borehole/ Pit No.	Depth m.	Sample	Description	Remarks
BH1	11.00	U6	Very stiff (Very high strength) fissured friable dark grey CLAY with fine and medium angular and subangular mudstone fragments and shell debris	Material noted as plotting below the A-Line

Initial Specimen	Height mm	Diameter mm	Weight g	Moisture Content %	Wet Density Mg/m^3	Dry Density Mg/m^3
Depth of Top of Specimen (m) 11.18	72.9	38.0	131	32	1.59	1.20

TEST INFORMATION — Rate of Strain 1.4 % per Min — Rubber Membrane Thickness 0.3 mm



Specimen at Failure	Measured Cell Pressure $\sigma 3$ (kPa)	Strain at Failure (%)	Stress Corrections (kPa)		Corrected Max. Deviator Stress $\sigma 1 - \sigma 3$ (kPa)	Shear Stress Cu $\frac{1}{2}(\sigma 1 - \sigma 3)_f$ (kPa)	Mohrs Circle Analysis	
			Rubber Membrane	Piston Friction			Cu (kPa)	PHI °
	218	19.0	2.9	/	337	169		

METHOD OF PREPARATION: BS 1377:PART 1:1990:

METHOD OF TEST : BS 1377:PART 7:1990:8 Definitive Method. 1990:9 Multi-stage loading

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter

COMMENTS : Tested in Vertical Orientation.
UKAS Calibration - loads from 0.2 to 10kN.

REMARKS TO INCLUDE : Sample disturbance, loss of moisture, variation from test procedure, location and origin of test specimen within original sample. Oven drying temperature if not 105-110 deg C.

TEST REPORT.

ISSUED BY : **SOIL PROPERTY TESTING LTD.**

DATE OF ISSUE : As page 1 **PAGE** 26 of 38

Contract Marsh Lane, Kings Lynn.

Serial No. S28408

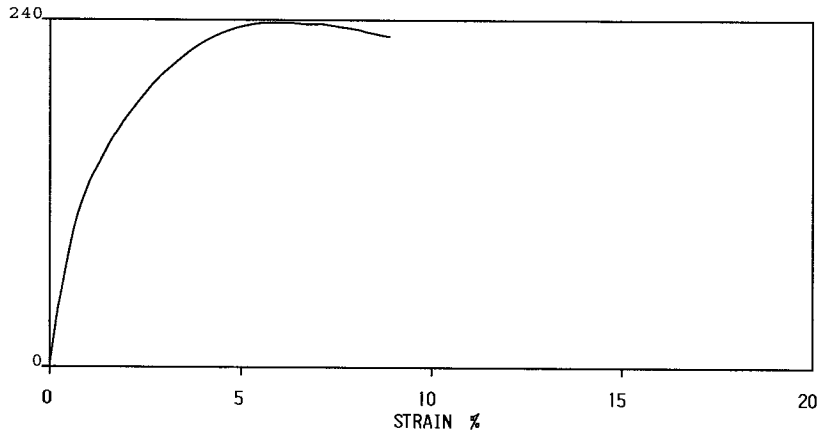
UKAS TESTING 0998

DETERMINATION OF UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION WITHOUT MEASUREMENT OF PORE PRESSURE

Borehole/ Pit No.	Depth m.	Sample	Description	Remarks
BH1	14.20	U7	Stiff (High strength) very dark grey CLAY with rare shell debris	

Initial Specimen	Height mm	Diameter mm	Weight g	Moisture Content %	Wet Density Mg/m^3	Dry Density Mg/m^3
Depth of Top of Specimen (m) 14.24	199.6	102.8	3231	27	1.95	1.54

TEST INFORMATION — Rate of Strain 2.0 % per Min — Rubber Membrane Thickness 0.3 mm



Specimen at Failure	Measured Cell Pressure $\sigma 3$ (kPa)	Strain at Failure (%)	Stress Corrections (kPa)		Corrected Max. Deviator Stress $\sigma 1 - \sigma 3$ (kPa)	Shear Stress Cu $\frac{1}{2}(\sigma 1 - \sigma 3)_f$ (kPa)	Mohrs Circle Analysis	
			Rubber Membrane	Piston Friction			Cu (kPa)	PHI °
	285	6.3	0.4	/	238	119		

METHOD OF PREPARATION: BS 1377:PART 1:1990:

METHOD OF TEST : BS 1377:PART 7:1990:8 Definitive Method. 1990:9 Multi-stage loading

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter

COMMENTS : Tested in Vertical Orientation.
UKAS Calibration - loads from 0.2 to 10kN.

REMARKS TO INCLUDE : Sample disturbance, loss of moisture, variation from test procedure, location and origin of test specimen within original sample. Oven drying temperature if not 105-110 deg C.

TEST REPORT.

ISSUED BY : SOIL PROPERTY TESTING LTD.

DATE OF ISSUE : As page 1 **PAGE** 27 of 38

Contract Marsh Lane, Kings Lynn.

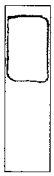
Serial No. S28408

UKAS TESTING 0998

DETERMINATION OF UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION WITHOUT MEASUREMENT OF PORE PRESSURE

Borehole/ Pit No.	Depth m.	Sample	Description	Remarks
BH2	3.00	U1	Stiff (High strength) dark grey slightly gravelly slightly sandy silty CLAY. Gravel is fine and medium chalk and rare flint	

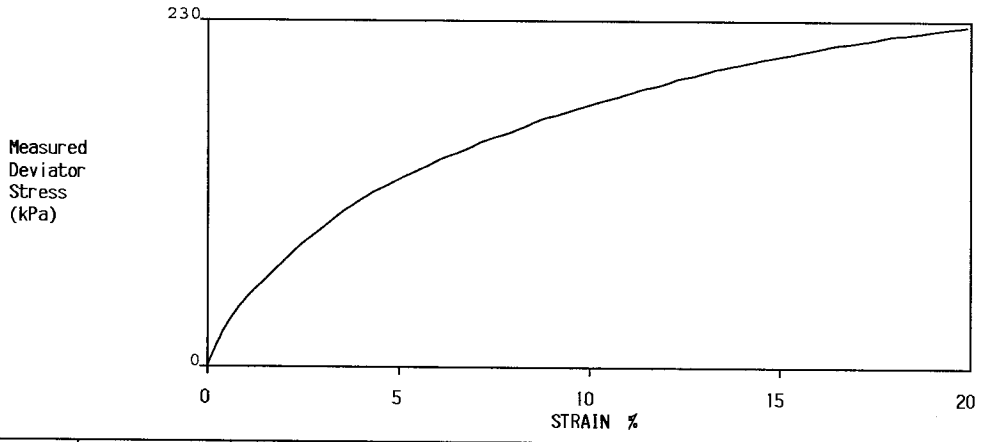
Initial Specimen



Depth of Top of Specimen (m): 3.03

Height mm	Diameter mm	Weight g	Moisture Content %	Wet Density Mg/m^3	Dry Density Mg/m^3
140.7	102.6	2499	18	2.15	1.82

TEST INFORMATION — Rate of Strain 1.9 % per Min — Rubber Membrane Thickness 0.6 mm



Specimen at Failure	Measured Cell Pressure $\sigma 3$ (kPa)	Strain at Failure (%)	Stress Corrections (kPa)		Corrected Max. Deviator Stress $\sigma 1 - \sigma 3$ (kPa)	Shear Stress Cu $\frac{1}{2}(\sigma 1 - \sigma 3)_f$ (kPa)	Mohrs Circle Analysis	
			Rubber Membrane	Piston Friction			Cu (kPa)	PHI °
	60	20.1	2.2	/	225	112		

METHOD OF PREPARATION: BS 1377:PART 1:1990:

METHOD OF TEST : BS 1377:PART 7:1990:8 Definitive Method. 1990:9 Multi-stage loading

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter

COMMENTS : Tested in Vertical Orientation.
UKAS Calibration - loads from 0.2 to 10kN.

REMARKS TO INCLUDE : Sample disturbance, loss of moisture, variation from test procedure, location and origin of test specimen within original sample. Oven drying temperature if not 105-110 deg C.

TEST REPORT.

ISSUED BY : SOIL PROPERTY TESTING LTD.

DATE OF ISSUE : As page 1 **PAGE** 28 of 38

Contract Marsh Lane, Kings Lynn.

Serial No. S28408

UKAS TESTING 0998

DETERMINATION OF UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION WITHOUT MEASUREMENT OF PORE PRESSURE

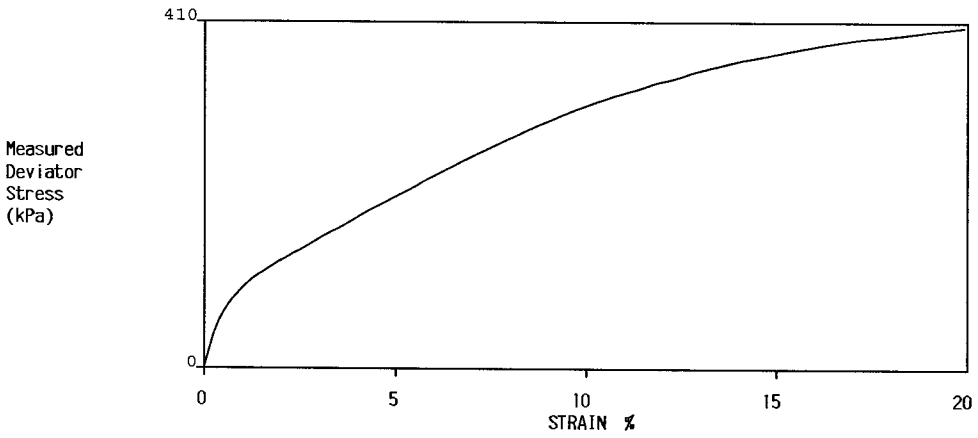
Borehole/ Pit No.	Depth m.	Sample	Description	Remarks
BH2	5.00	U2	Very stiff (Very high strength) dark grey slightly gravelly slightly sandy silty CLAY. Gravel is fine and medium chalk and rare flint	

Initial Specimen

Depth of Top of Specimen (m) 5.06

Height mm	Diameter mm	Weight g	Moisture Content %	Wet Density Mg/m^3	Dry Density Mg/m^3
199.6	102.7	3549	18	2.15	1.82

TEST INFORMATION — Rate of Strain 1.4 % per Min — Rubber Membrane Thickness 0.6 mm



Specimen at Failure	Measured Cell Pressure $\sigma 3$ (kPa)	Strain at Failure (%)	Stress Corrections (kPa)		Corrected Max. Deviator Stress $\sigma 1 - \sigma 3$ (kPa)	Shear Stress Cu $\frac{1}{2}(\sigma 1 - \sigma 3)_f$ (kPa)	Mohrs Circle Analysis	
			Rubber Membrane	Piston Friction			Cu (kPa)	PHI °
	99	20.1	2.2	/	403	201		

METHOD OF PREPARATION: BS 1377:PART 1:1990:

METHOD OF TEST : BS 1377:PART 7:1990:8 Definitive Method. 1990:9 Multi-stage loading

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter

COMMENTS : Tested in Vertical Orientation.
UKAS Calibration - loads from 0.2 to 10kN.

REMARKS TO INCLUDE : Sample disturbance, loss of moisture, variation from test procedure, location and origin of test specimen within original sample. Oven drying temperature if not 105-110 deg C.

TEST REPORT.

ISSUED BY : SOIL PROPERTY TESTING LTD.

DATE OF ISSUE : As page 1 **PAGE** 29 of 38

Contract Marsh Lane, Kings Lynn.

Serial No. S28408

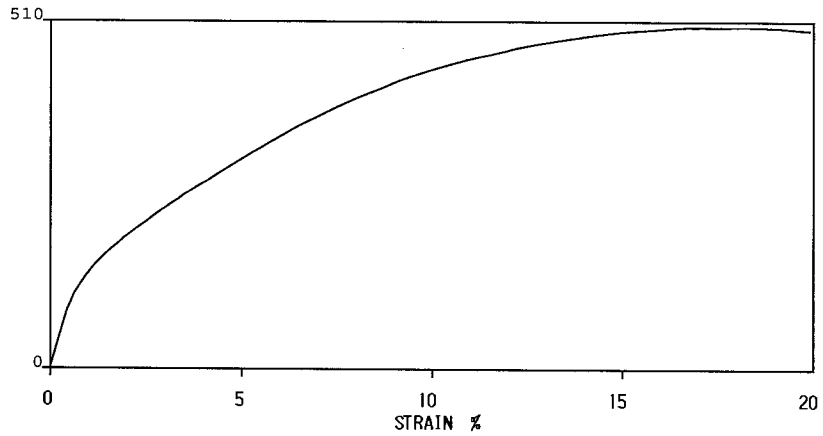
UKAS TESTING 0998

DETERMINATION OF UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION WITHOUT MEASUREMENT OF PORE PRESSURE

Borehole/ Pit No.	Depth m.	Sample	Description	Remarks
BH2	8.00	U3	Very stiff (Very high strength) dark grey slightly gravelly slightly sandy silty CLAY. Gravel is fine to coarse chalk and rare flint	

Initial Specimen	Height mm	Diameter mm	Weight g	Moisture Content %	Wet Density Mg/m^3	Dry Density Mg/m^3
Depth of Top of Specimen (m) 8.09	200.2	102.8	3538	16	2.13	1.84

TEST INFORMATION — Rate of Strain 1.3 % per Min — Rubber Membrane Thickness 0.3 mm



Specimen at Failure	Measured Cell Pressure $\sigma 3$ (kPa)	Strain at Failure (%)	Stress Corrections (kPa)		Corrected Max. Deviator Stress $\sigma 1 - \sigma 3$ (kPa)	Shear Stress Cu $\frac{1}{2}(\sigma 1 - \sigma 3)_f$ (kPa)	Mohrs Circle Analysis	
			Rubber Membrane	Piston Friction			Cu (kPa)	PHI °
	160	16.9	1.0	/	501	251		

METHOD OF PREPARATION: BS 1377:PART 1:1990:

METHOD OF TEST : BS 1377:PART 7:1990:8 Definitive Method. 1990:9 Multi-stage loading

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter

COMMENTS : Tested in Vertical Orientation.
UKAS Calibration - loads from 0.2 to 10kN.

REMARKS TO INCLUDE : Sample disturbance, loss of moisture, variation from test procedure, location and origin of test specimen within original sample. Oven drying temperature if not 105-110 deg C.

TEST REPORT.

ISSUED BY : **SOIL PROPERTY TESTING LTD.**

DATE OF ISSUE : As page 1 **PAGE** 30 **of** 78

Contract Marsh Lane, Kings Lynn.

Serial No. S28408

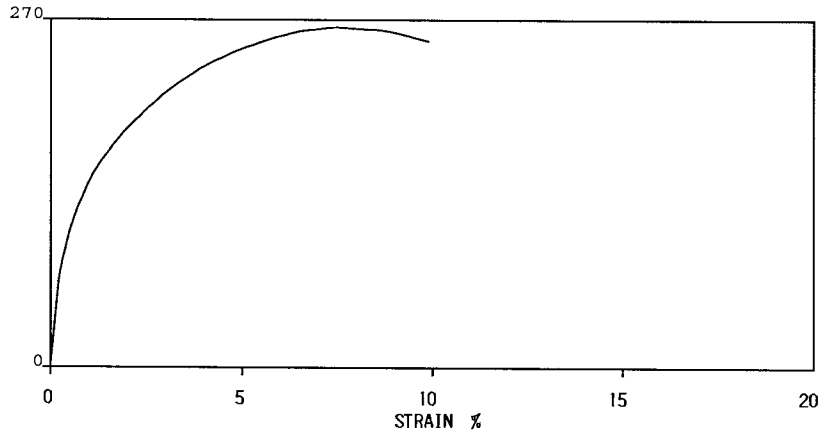
UKAS TESTING 0998

DETERMINATION OF UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION WITHOUT MEASUREMENT OF PORE PRESSURE

Borehole/ Pit No.	Depth m.	Sample	Description	Remarks
BH2	11.00	U4	Stiff (High strength) fissured dark grey CLAY	

Initial Specimen	Height mm	Diameter mm	Weight g	Moisture Content %	Wet Density Mg/m^3	Dry Density Mg/m^3
Depth of Top of Specimen (m) 11.17	199.6	103.0	3394	24	2.04	1.65

TEST INFORMATION — Rate of Strain 1.0 % per Min — Rubber Membrane Thickness 0.3 mm



Specimen at Failure	Measured Cell Pressure $\sigma 3$ (kPa)	Strain at Failure (%)	Stress Corrections (kPa)		Corrected Max. Deviator Stress $\sigma 1 - \sigma 3$ (kPa)	Shear Stress Cu $\frac{1}{2}(\sigma 1 - \sigma 3)_f$ (kPa)	Mohrs Circle Analysis	
			Rubber Membrane	Piston Friction			Cu (kPa)	PHI °
	219	7.3	0.4	/	264	132		

METHOD OF PREPARATION: BS 1377:PART 1:1990:

METHOD OF TEST : BS 1377:PART 7:1990:8 Definitive Method. 1990:9 Multi-stage loading

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter

COMMENTS : Tested in Vertical Orientation.
UKAS Calibration - loads from 0.2 to 10kN.

REMARKS TO INCLUDE : Sample disturbance, loss of moisture, variation from test procedure, location and origin of test specimen within original sample. Oven drying temperature if not 105-110 deg C.

TEST REPORT.

ISSUED BY : SOIL PROPERTY TESTING LTD.

DATE OF ISSUE : As page 1 **PAGE** 31 of 38

Contract Marsh Lane, Kings Lynn.

Serial No. S28408

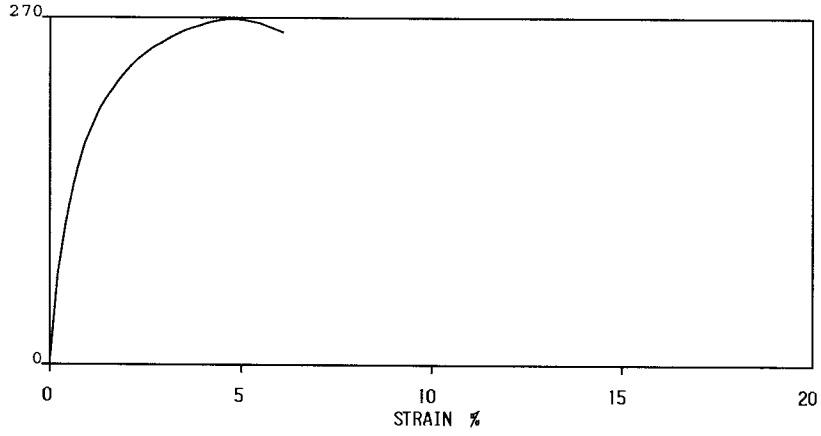
UKAS TESTING 0998

DETERMINATION OF UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION WITHOUT MEASUREMENT OF PORE PRESSURE

Borehole/ Pit No.	Depth m.	Sample	Description	Remarks
BH2	13.50	U5	Stiff (High strength) fissured dark grey CLAY with occasional shell debris	

Initial Specimen	Height mm	Diameter mm	Weight g	Moisture Content %	Wet Density Mg/m^3	Dry Density Mg/m^3
Depth of Top of Specimen (m) 13.57	199.8	102.6	3280	26	1.98	1.57

TEST INFORMATION — Rate of Strain 1.0 % per Min — Rubber Membrane Thickness 0.3 mm



Specimen at Failure	Measured Cell Pressure $\sigma 3$ (kPa)	Strain at Failure (%)	Stress Corrections (kPa)		Corrected Max. Deviator Stress $\sigma 1 - \sigma 3$ (kPa)	Shear Stress Cu $\frac{1}{2}(\sigma 1 - \sigma 3)_f$ (kPa)	Mohrs Circle Analysis	
			Rubber Membrane	Piston Friction			Cu (kPa)	PHI °
	269	4.7	0.4	/	269	134		

METHOD OF PREPARATION: BS 1377:PART 1:1990:

METHOD OF TEST : BS 1377:PART 7:1990:8 Definitive Method. 1990:9 Multi-stage loading

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter

COMMENTS : Tested in Vertical Orientation.
UKAS Calibration - loads from 0.2 to 10kN.

REMARKS TO INCLUDE : Sample disturbance, loss of moisture, variation from test procedure, location and origin of test specimen within original sample. Oven drying temperature if not 105-110 deg C.

TEST REPORT.

ISSUED BY : SOIL PROPERTY TESTING LTD.

DATE OF ISSUE : As page 1 **PAGE** 32 of 38

Contract Marsh Lane, Kings Lynn.

Serial No. S28408

UKAS TESTING 0998

DETERMINATION OF UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION WITHOUT MEASUREMENT OF PORE PRESSURE

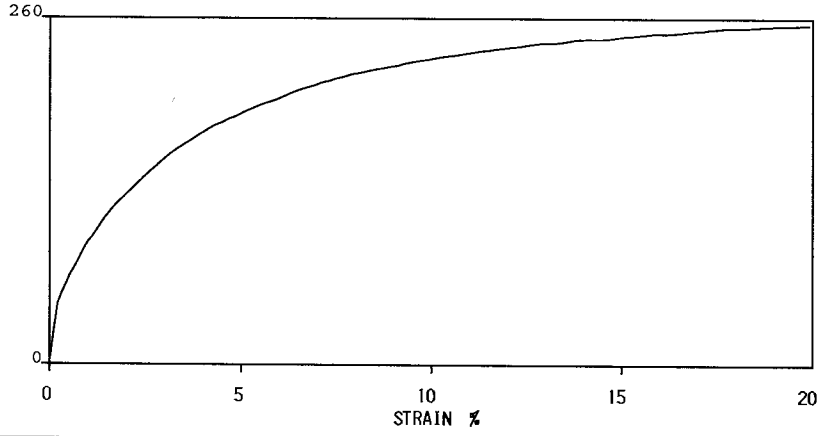
Borehole/ Pit No.	Depth m.	Sample	Description	Remarks
BH3	3.60	U3	Stiff (High strength) dark grey slightly gravelly slightly sandy silty CLAY with occasional olive mottling and rare selenite crystals. Gravel is fine and medium chalk	Oven dried at a maximum of 80°C due to the presence of selenite

Initial Specimen

Depth of Top of Specimen (m): 3.72

Height mm	Diameter mm	Weight g	Moisture Content %	Wet Density Mg/m^3	Dry Density Mg/m^3
199.8	103.1	3462	19	2.07	1.74

TEST INFORMATION — Rate of Strain 1.0 % per Min — Rubber Membrane Thickness 0.6 mm



Specimen at Failure	Measured Cell Pressure $\sigma 3$ (kPa)	Strain at Failure (%)	Stress Corrections (kPa)		Corrected Max. Deviator Stress $\sigma 1 - \sigma 3$ (kPa)	Shear Stress Cu $\frac{1}{2}(\sigma 1 - \sigma 3)_f$ (kPa)	Mohrs Circle Analysis	
			Rubber Membrane	Piston Friction			Cu (kPa)	PHI °
	76	19.9	2.2	/	253	127		

METHOD OF PREPARATION: BS 1377:PART 1:1990:

METHOD OF TEST : BS 1377:PART 7:1990:8 Definitive Method. 1990:9 Multi-stage loading

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter

COMMENTS : Tested in Vertical Orientation.
UKAS Calibration - loads from 0.2 to 10kN.

REMARKS TO INCLUDE : Sample disturbance, loss of moisture, variation from test procedure, location and origin of test specimen within original sample. Oven drying temperature if not 105-110 deg C.

TEST REPORT.

ISSUED BY : **SOIL PROPERTY TESTING LTD.**

DATE OF ISSUE : As page 1 **PAGE** 33 of 38

Contract Marsh Lane, Kings Lynn.

Serial No. S28408

UKAS TESTING 0998

DETERMINATION OF UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION WITHOUT MEASUREMENT OF PORE PRESSURE

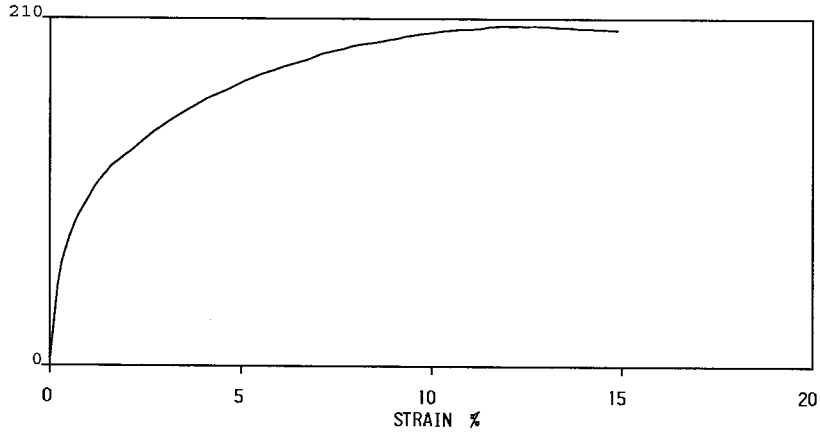
Borehole/ Pit No.	Depth m.	Sample	Description	Remarks
BH3	5.60	U4	Stiff (High strength) fissured dark grey CLAY with rare selenite crystals	Oven dried at a maximum of 80°C due to the presence of selenite

Initial Specimen

Depth of Top of Specimen (m): 5.75

Height mm	Diameter mm	Weight g	Moisture Content %	Wet Density Mg/m^3	Dry Density Mg/m^3
199.5	102.8	3405	26	2.06	1.63

TEST INFORMATION — Rate of Strain 1.0 % per Min — Rubber Membrane Thickness 0.3 mm



Specimen at Failure	Measured Cell Pressure $\sigma 3$ (kPa)	Strain at Failure (%)	Stress Corrections (kPa)		Corrected Max. Deviator Stress $\sigma 1 - \sigma 3$ (kPa)	Shear Stress Cu $\frac{1}{2}(\sigma 1 - \sigma 3)_f$ (kPa)	Mohrs Circle Analysis	
			Rubber Membrane	Piston Friction			Cu (kPa)	PHI °
	113	11.7	0.7	/	206	103		

METHOD OF PREPARATION: BS 1377:PART 1:1990:

METHOD OF TEST : BS 1377:PART 7:1990:8 Definitive Method. 1990:9 Multi-stage loading

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter

COMMENTS : Tested in Vertical Orientation.
UKAS Calibration - loads from 0.2 to 10kN.

REMARKS TO INCLUDE : Sample disturbance, loss of moisture, variation from test procedure, location and origin of test specimen within original sample. Oven drying temperature if not 105-110 deg C.

TEST REPORT.

ISSUED BY : **SOIL PROPERTY TESTING LTD.**

DATE OF ISSUE : As page 1 **PAGE** 34 **of** 38

Contract Marsh Lane, Kings Lynn.

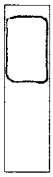
Serial No. S28408

UKAS TESTING 0998

DETERMINATION OF UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION WITHOUT MEASUREMENT OF PORE PRESSURE

Borehole/ Pit No.	Depth m.	Sample	Description	Remarks
BH3	10.80	U5	Stiff (High strength) fissured dark grey CLAY with frequent shell debris	

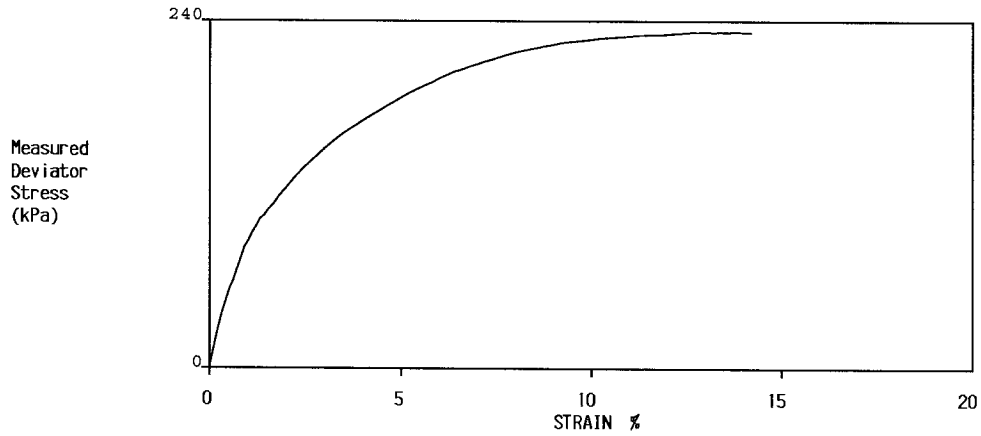
Initial Specimen



Depth of Top of Specimen (m): 10.88

Height mm	Diameter mm	Weight g	Moisture Content %	Wet Density Mg/m^3	Dry Density Mg/m^3
155.9	103.0	2516	28	1.94	1.52

TEST INFORMATION — Rate of Strain 1.2 % per Min — Rubber Membrane Thickness 0.3 mm



Specimen at Failure	Measured Cell Pressure $\sigma 3$ (kPa)	Strain at Failure (%)	Stress Corrections (kPa)		Corrected Max. Deviator Stress $\sigma 1 - \sigma 3$ (kPa)	Shear Stress Cu $\frac{1}{2}(\sigma 1 - \sigma 3)_f$ (kPa)	Mohrs Circle Analysis	
			Rubber Membrane	Piston Friction			Cu (kPa)	PHI °
	215	13.6	0.8	/	232	116		

METHOD OF PREPARATION: BS 1377:PART 1:1990:

METHOD OF TEST : BS 1377:PART 7:1990:8 Definitive Method. 1990:9 Multi-stage loading

TYPE OF SAMPLE KEY : U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter

COMMENTS : Tested in Vertical Orientation.
UKAS Calibration - loads from 0.2 to 10kN.

REMARKS TO INCLUDE : Sample disturbance, loss of moisture, variation from test procedure, location and origin of test specimen within original sample. Oven drying temperature if not 105-110 deg C.